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THE TENNESSEE VALLEY AUTHORITY
BUREAU OF WATER CONTROL PLANNING

FLOODS
ON
FRENCH BROAD RIVER
IN VICINITY OF
MARSHALL, NORTH CAROLINA

REPORT NO. 1007

RESEARCH DIVISION

1944



TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

FLOODS
ON
FRENCH BROAD RIVER
IN VICINITY OF
MARSHALL, NORTH CAROLINA

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COVER PHOTO

This view shows part of the heavy damage sustained by the Southern Railway during the flood of August 30, 1940. The picture is looking downstream toward the upper bridge at Marshall shortly after the French Broad River had returned within its banks. (Asheville "Citizen-Times" photo)

FOREWORD

Tennessee Valley Authority
Division of Water Control Planning

FOREWORD

This report relates to the flood situation along the French Broad River in the vicinity of Marshall, North Carolina. It has been prepared at the request of the Marshall City Council through the North Carolina Department of Water Resources to aid (1) in the solution of local flood problems and (2) in the best utilization of lands subject to overflow. The report is based on work the TVA has been carrying on since its beginning in connection with its water resource operations throughout the Tennessee Valley. TVA has assembled information on rainfall, runoff, historical and current flood heights, and other technical data bearing on the occurrence and magnitude of floods in localities throughout the region which provide the basis for preparation of the report.

The report does not include plans for the solution of flood problems. Rather, it is intended to provide a basis for further study and planning on the part of the town of Marshall in arriving at solutions to minimize vulnerability to flood damages. This might involve (1) construction of flood protection works, (2) local planning programs to guide developments by controlling the type of use made of the flood plain through zoning and subdivision regulations, or (3) a combination of the two approaches.

The report covers three significant phases of the Marshall flood problem. The first brings together a record of the largest known floods of the past on the French Broad River. The second treats of the Regional Flood. This is derived from consideration of the largest floods known to have occurred on streams of similar physical characteristics in the same general geographical region as that of the French Broad River and generally within 100 miles of Marshall. The third develops the Maximum Probable Flood for the French Broad River. Floods of this magnitude on most streams are considerably larger than any that have occurred in the past. They are the floods of infrequent occurrence that are considered in planning protective works, the failure of which might be disastrous. Such floods are used by TVA in the design of the physical features of reservoirs, dams, powerhouses, and local flood protection works.

The report contains maps, profiles, and valley cross sections which indicate the extent of flooding that has been experienced and that might occur in the future in Marshall.

In problems concerned with the control of developments in the flood plain of the French Broad River, and in reaching decisions on the magnitude of floods to consider for this purpose, appropriate consideration should be given to the possible future occurrence of floods of the magnitude of (1) those that have occurred in the past, (2) the Regional Flood derived from those that have occurred on streams of similar physical characteristics in the region of Marshall, and (3) the Maximum Probable Flood that it is estimated might occur.

This report should be useful in planning new developments in the flood plain. From the maps, profiles, and cross sections, the depth of probable flooding by either recurrence of the largest known historic flood or by occurrence of the Regional or Maximum Probable Floods at any location may be ascertained. Having this information, floor levels for buildings may be planned either high enough to avoid flood damage or at lower elevations with recognition of the chance and hazards of flooding that are being taken.

I.
RESUME
OF
FLOOD SITUATION



Figure 1. --MARSHALL AFTER THE JULY 1916 FLOOD

At the crest stage, the swift flood waters on July 16, 1916, were 5 feet deep on the street in front of the courthouse and 7 to 8 feet deep over the Southern Railway. The tracks, which followed the masonry wall, were washed out. The only remaining span of the lower bridge is in the foreground. (Photo by Southern Railway Company)

Tennessee Valley Authority
Division of Water Control Planning

I.

RESUME OF FLOOD SITUATION

Marshall, North Carolina, is located on the French Broad River about 125 miles above the mouth and 22 river miles below Asheville. Four miles of the river's course are within the corporate limits of Marshall but the development of the town is largely on the right side of the river along the upper half of this reach. The newer residential areas of the town lie on high ground north of the river but older residences and all the business development are on the flood plain. The river watershed above the business section covers 1,338 square miles.

The relatively narrow flood plain of the river through Marshall is highly developed with almost every bit of the usable land in use. Three school buildings and the playground of the Marshall School are on Blennerhassett Island opposite the heart of the business district. The town has experienced overflows a number of times since it was incorporated over 100 years ago, the largest of these being in July 1916. In August 1940 a flood occurred which was not quite so high as the 1916 flood but which caused considerably more damage due to the added development in the intervening years.

Fairly complete observations of stream stages have been made on the French Broad River at Marshall since 1917. Continuous records of stages and river discharges are available since 1942. In compiling a record of early floods it has been necessary to interview residents along the river who have knowledge of these floods and to conduct research in newspaper files and historical documents. From these investigations and from studies of possible future floods on French Broad River in the vicinity of Marshall, the flood situation, both past and future, has been developed. The following paragraphs summarize the significant findings with regard to the flood situation which are described in more detail in succeeding sections of this report.

- THE GREATEST FLOOD in more than 170 years on the French Broad River in the Marshall vicinity occurred on July 16, 1916. Rising at the rate of 2.5 feet per hour, this great flood drowned two people, inundated all but three buildings on Main Street, washed away many homes and other buildings, destroyed two highway bridges, and caused heavy damage to the Southern Railway.
- OTHER BIG FLOODS reaching within 3 to 4 feet of the 1916 crest occurred on July 17, 1876, February 28, 1902, and August 30, 1940.
- A REGIONAL FLOOD on the French Broad River at Marshall, based on floods experienced on streams within 100 miles of Marshall, would be of approximately the same magnitude as the 1916 flood. The latter flood is considered to be the Regional Flood in this report. (Figures 1 and 4 show the effect of the 1916 flood at Marshall and Figures 12 to 15 in Section IV of this report show the height reached by the flood in the city.)
- MAXIMUM PROBABLE FLOOD determinations indicate that floods could occur on the French Broad River at Marshall 9 to 17 feet higher than the 1916 flood. Floods of this magnitude could be expected to occur only rarely. (Figures 12 to 15 in Section IV of this report show the height of the Maximum Probable Flood.)
- FLOOD DAMAGES that result from floods as large as those of 1916 and 1940 are great at Marshall. Such floods inundate the entire business district on the flood plain to depths of as much as 10 and 7 feet, respectively, and submerge the island upon which the city schools are located. This deep overflow, coupled with high velocities, has caused severe damage to buildings and their contents. The Maximum Probable Flood, with its great depth and high velocities, would cause even heavier damage.
- MOST FREQUENT FLOOD OCCURRENCES on the French Broad River at Marshall have been in the winter and early spring. However, most of the higher floods of the past have occurred in the May through August period. The rainfall causing these summer floods has come from tropical hurricane storms and intense widespread thunderstorm activity.

- CHARACTERISTICS OF THE WATERSHED above Marshall are such that serious flooding can result from storms concentrated in the 393-square mile local area between Asheville and Marshall, as well as from more widespread storms. This local area contributed greatly to the damaging flood peak of August 30, 1940. Also important in its effect on flood heights at Marshall is the natural storage of flood waters resulting from the flat channel slope and wide flood plain of the French Broad River upstream from Asheville.
- OBSTRUCTIONS TO FLOW result from the extensive flood plain development through Marshall. The nearly solid mass of buildings on the right bank flood plain leave only Main Street and the Southern Railway for free flow of flood waters. Added to these obstructions are two highway bridges, school buildings on Blennerhasset Island, the Capitola Dam and flume. Redmon Dam below the town backs water up to the lower end of the business district.
- ICE JAMS during some winter seasons are severe and create a flood hazard resulting in water inundating parts of the city to depths of a few feet. The most recent occurrence was in February 1958.
- LOCAL FLOOD PROTECTION investigations made by TVA soon after the 1940 flood indicated that protection could best be provided by a concrete levee wall along the right edge of the river. On the basis of costs and property values as of 1941, the benefits that could be realized from the necessary protection works were considerably less than the estimated cost of the project. No re-evaluation based on present conditions has been made.
- VELOCITIES OF WATER averaged 10 to 15 feet per second in the channel of the French Broad River during the July 1916 flood. On the flood plain along Main Street and the railway tracks, velocities were in the order of 5 feet per second. During a Maximum Probable Flood, velocities would range up to 18 feet per second in the channel and up to 17 feet per second in the flood plain.

● DURATION OF FLOODS AT MARSHALL is relatively short, considering the size of the watershed. This is particularly true of the summer floods. The August 30, 1940, flood was above bankfull stage for 33 hours, but serious flooding in the streets lasted less than half of this time. The 1940 flood rose at an average rate of 1.1 feet per hour. The average rate of rise during the 1916 flood was 2.5 feet per hour. Floods of the magnitude of the Maximum Probable Flood would rise about 37 feet from low water to the crest stage in about 8 hours, and the maximum rate of rise would be about 6 feet per hour.

● EXTREMELY HAZARDOUS CONDITIONS may be expected during large future floods. The entire business district of Marshall would be flooded, with water flowing swiftly along Main Street as much as 26 feet deep. Some buildings would be submerged; many would be swept away by the high velocities, endangering the lives of their occupants.

● FUTURE FLOOD HEIGHTS that would be reached if floods of the magnitudes of the Regional and Maximum Probable occurred are shown by the following Table 1. This compares the flood crests with the crests of the 1940 flood at the upper bridge at Marshall.

TABLE 1
RELATIVE FLOOD HEIGHTS
AT MARSHALL

<u>Flood</u>	<u>Location</u>	<u>Mile</u>	<u>Estimated Peak Discharge cubic feet per second</u>	<u>Above 1940 Flood feet</u>
1940	Upper Bridge	125.21	70,000	0
Regional*			115,000	3.7
Maximum Probable			200,000	20.0

*Of same magnitude as the 1916 flood. Discharge for 1916 flood determined at U. S. Geological Survey gage, Mile 126.7.

II.

PAST FLOODS



Tennessee Valley Authority
Division of Water Control Planning
Hydraulic Data Branch

II.

PAST FLOODS

This section of the report is a history of floods which have occurred on the French Broad River at Marshall, Madison County, North Carolina. The portion of the river considered extends from the upper corporate limit, Mile 126.78 to Mile 124.40, just below the town's business district, a distance of 2.4 river miles.

The French Broad River flows westward through Marshall in a rough, boulder strewn channel, some 400 to 500 feet below the top of the steep hills which overlook its course through much of Madison County. The Marshall business district lies on a narrow flood plain 100 to 400 feet wide, on the right side of the channel. The Marshall School is situated on Blennerhassett Island, a large island opposite the business district.

Records of flood crest stages on the French Broad River at Marshall are practically complete since December 1, 1917, when the U. S. Weather Bureau established a non-recording gage at the upper bridge. A gage was observed at the same location in 1902-1903. In October 1942, the U. S. Geological Survey established a recording stream gage near the upper city limits at Mile 126.7. Flood history investigations made by TVA Hydraulic Data Branch engineers along the entire French Broad River in 1937 developed information available on floods prior to the beginning of stream gage records. Field investigations have been made by engineers of the Hydraulic Data Branch immediately following all the significant floods on the French Broad River in the last 25 years. Extensive investigations were made in the Marshall area following the floods of August 14 and 30, 1940. Local residents have been interviewed. Newspaper files and historical sources have been searched. From these sources it has been possible to develop a history of known large floods on the French Broad River at Marshall covering the past 170 years.

FRENCH BROAD RIVER VALLEY

Settlement

Madison County was formed in 1851 from a part of Buncombe and Yancey Counties. It was decided at that time to name the county seat in honor of John Marshall, for 34 years Chief Justice of the U. S. Supreme Court. However, it was 1857 before the present site for the county seat was agreed upon.

The route along the French Broad River was an important artery of travel from the earliest settlement of the area. A toll road, the Buncombe Turnpike, was built with state support along this route in 1827. In 1836 there was a community known as Lapland at the present site of Marshall.

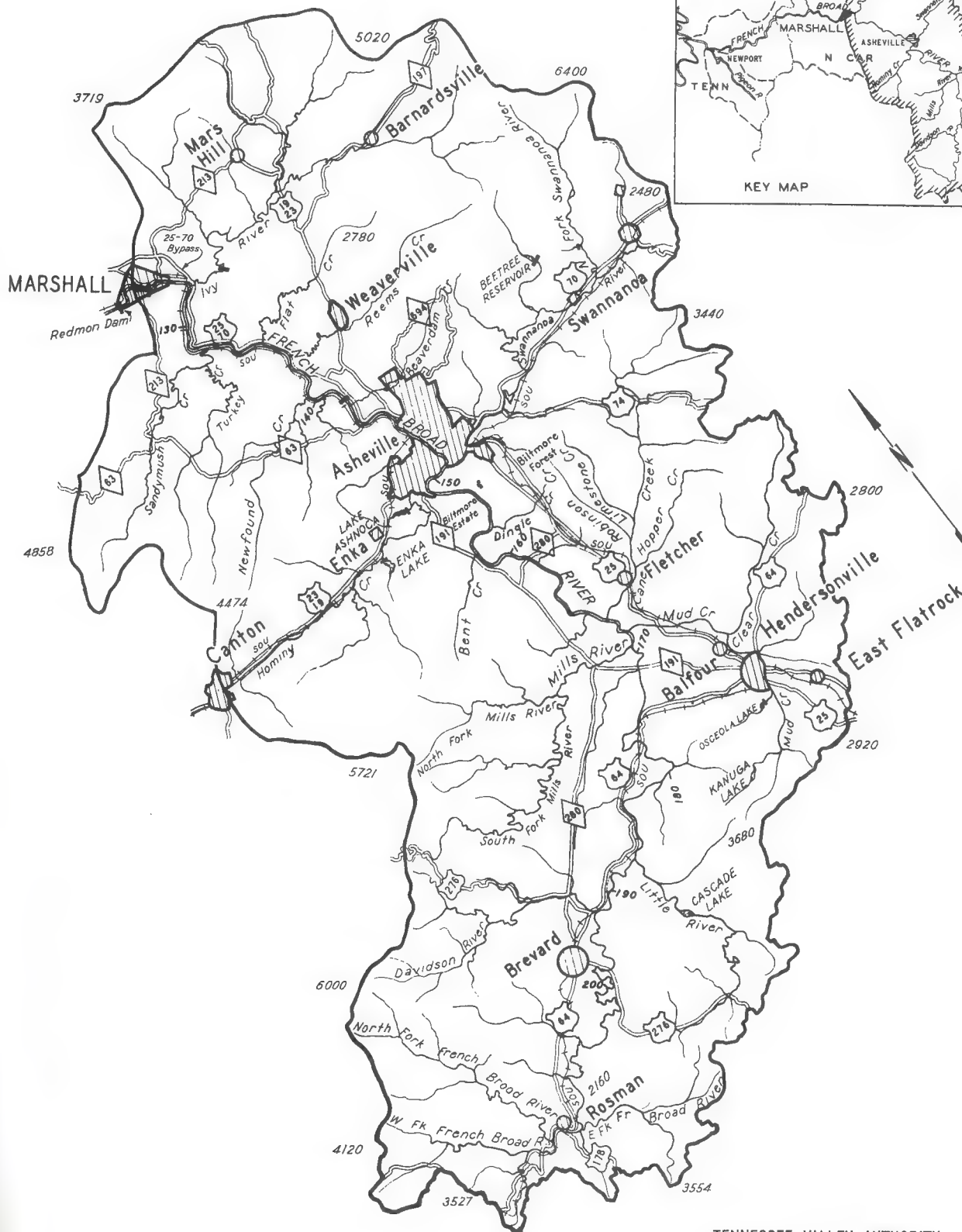
Railroad service reached Marshall from Asheville in 1882. The line, later to be connected through to Knoxville, is now part of the Southern Railway system and is a principal route of north-south rail traffic.

The 1950 census lists a population of 20,522 for Madison County and 983 for Marshall.

The Stream and Its Valley

The French Broad River watershed covers an area of 5,124 square miles of which the upper one-half is in North Carolina and the lower one-half is in Tennessee. The drainage area above Marshall, Plate 1, measuring 1,338 square miles above Upper Bridge Street, is about 60 miles long and has an average width of about 22 miles. The river originates on the Blue Ridge which separates the Tennessee Valley drainage from that flowing to the east toward the Atlantic Ocean. The watershed lies within the four North Carolina counties of Transylvania, Henderson, Buncombe, and Madison and is in the Appalachian Mountain physiographic sub-region. The land in the watershed is about 75 percent in forest cover.

The river begins at Rosman, North Carolina, 50 miles south of Marshall, where four tributaries converge. These four streams drop steeply from the watershed rim, where elevations range from near 3,000 feet to as much



TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

WATERSHED MAP
FRENCH BROAD RIVER
ABOVE MARSHALL, NORTH CAROLINA

Scale 0 5 10 Miles

MAY 1960

as 6,000 feet. From Rosman to Asheville, 20 miles upstream from Marshall, the river follows a meandering course through a broad flood plain with a channel slope much flatter than is usual for a mountain stream. The wide bottoms in this reach provide substantial natural storage of flood waters. This has a significant effect on the timing and height of floods at Marshall, particularly those resulting from heavy upstream storms. The part of the watershed between Asheville and Marshall, measuring 393 square miles in area, is more mountainous and the river flows in a relatively narrow gorge with steep channel slopes.

From Rosman to Long Shoals, a short distance upstream from Asheville, the French Broad River falls on an average of 2.5 feet per mile, and from here to the downstream limit of Asheville the rate of fall is 5 feet per mile. From Asheville through Marshall the rate of fall is 16.7 feet per mile. For the 2.4-mile reach covered by this investigation the low water level of the river falls from elevation 1649 to elevation 1622, or about 12 feet per mile.

Pertinent drainage areas in the vicinity of Marshall are given in Table 2.

TABLE 2
DRAINAGE AREAS IN WATERSHED
OF FRENCH BROAD RIVER

<u>Stream</u>	<u>Location</u>	<u>Mile Above Mouth</u>	<u>Drainage Area sq. mi.</u>
French Broad River	Asheville	145.8	945
	Above Ivy River	127.7	1,170
	Below Ivy River	127.7	1,331
	Marshall--		
	USGS stream gage	126.7	1,332
	Upper Bridge	125.2	1,338
Ivy River	Mouth	0.0	161

The character of the watershed above Marshall is such that damaging floods can result not only from general storms which affect the whole watershed, but also from runoff which comes primarily from the part of the watershed between

Asheville and Marshall. Because of the influence of this area from which the runoff concentrates rapidly, flood peaks often occur at Marshall before they occur at Asheville. In all major rises the peak occurs at both Marshall and Asheville well ahead of the peak in the very flat reach of the river above Asheville. In the flood of August 30, 1940, when most of the Marshall business section was overflowed, more than 70 percent of the flow at the time of the peak stage at Marshall came from the area between Asheville and Marshall, although this area represented only about 30 percent of the total drainage area above Marshall. The 161-square mile Ivy River, the largest tributary in this reach, joining the French Broad River two miles above Marshall, can produce a major flood at Marshall with only moderate contribution from other streams. On the other hand, major floods at Marshall can result from storms which affect principally the headwater areas. Such a flood was the one which occurred in July 1916.

The corporate limits of Marshall lie on either side of the French Broad River between river Miles 122.8 and 126.8. The commercial and residential development of the city extends only over the upper two miles of this reach, however, or from Mile 124.7, just below Blennerhassett Island, to Mile 126.8. This is within the reach covered by this investigation.

Flood plain widths from the upper corporate limit downstream through the Rollins community to the upper end of the Marshall business district, vary from only a few feet to about three hundred feet. Through the business district the right bank flood plain widens gradually to about 400 feet at the Court House, opposite Lower Bridge Street, then narrows to about 200 feet at the lower end of the business district, at Frisby Branch. The left bank flood plain is narrow throughout the reach, except for an undeveloped, relatively inaccessible reach upstream from the business section. From Lower Bridge Street downstream the width of the left bank flood plain is not over 200 feet at any place.

Blennerhassett Island divides the normal flow of the river into two channels. The island is 1450 feet long by 550 feet at the widest point and extends from Lower Bridge Street to Frisby Branch. The mean height of the island is about eight feet above low water. In large floods, which overflow Blennerhassett Island and the business district, a maximum width of overflow of 1200 feet occurs

at the mid-point of the island. Frisby Branch, just downstream from the business district and Hayes Run, 0.7 mile upstream from the business district, are tributaries which enter French Broad River from the right bank in the Marshall reach. Both drain small areas and have an insignificant effect on floods.

Developments in the Flood Plain

Plates 8 and 9 show the narrow but highly developed flood plain of the French Broad River through Marshall. Plate 9 shows the business district which now includes a total of 107 buildings within the area flooded in July 1916. Table 3 identifies the numbered buildings on Plate 9. The buildings shown include commercial establishments of every variety and also the Court House, jail, railway station, three churches, and some 20 dwellings. Elsewhere on the flood plain are another 20 homes and a number of other commercial establishments. The three buildings of the Marshall School are located on Blennerhassett Island, housing both the elementary and high school grades. A fourth building is being contemplated here to meet the growing needs of the school.

The business section of Marshall is on the right bank with the buildings nearly all facing on Main Street, which runs parallel to the river and is the only through street in the town. Short cross streets, called Upper Bridge Street and Lower Bridge Street, connect Main Street to the two bridges, and a street one block long runs between the two cross streets parallel to Main Street. The tracks of the Southern Railway are on the right bank near the water edge and are protected from moderate floods by a heavy masonry wall extending the full length of the business district. The flood of July 1916 covered all the flood plain and put water 6 to 8 feet deep along most of Main Street. Water was over the railroad tracks and was 13 to 18 feet over the land on Blennerhassett Island. The flood of August 30, 1940, overflowed practically the same area as the 1916 flood, but overflow depths were two to four feet less.

U. S. Highways 25 and 70, which formerly followed Main Street through Marshall, now follow a new by-pass route which leaves the river at the mouth of Ivy River, Mile 127.7, and continues on high ground about one mile

TABLE 3

BUILDING IDENTIFICATION FOR PLATE 9

MAIN STREET

<u>No.</u>	<u>Name</u>	<u>No.</u>	<u>Name</u>
	*Northside, east to west:	10)	Warehouse
1	Teague Milling Co.	48)	
2	Garren Auto Supply	11	Sprinkle-Shelton Distrib. Co.
41	Vacant		(Upper Bridge Street)
3	C. W. Ward Gulf Service	33)	
30	Edwards Dry Cleaning	44)	Texaco Service
31	Phillips 66 Service	U2	All Seasons Heating Co.
-	Presbyterian Church	71	U. S. Post Office
4	Firestone Tire Recapping	13	Belk's Department Store
27)		25	Bowman-Rector Funeral Home
50)	French Broad Chevrolet Co.	19)	
51	Marshall News-Record	61)	Dixie Grocery
57	Vacant	61	Variety Store
5	Bob Davis Store	62)	
32	Esso Service	63)	Citizen's Bank
	(Hill Street)	26	National 5 & 10 Cent Store
59	Wild's Radio and TV	14	Penland's Dept. Store
-	Baptist Church	64	Beauty Shop
6	Stuart Tourist Home	45	Department Store
43	Vacant	20	Grocery
49	Vacant	20	Barber Shop
60	Bank of the French Broad	65	Grocery
-	Courthouse	21	McKinny's Dept. Store
7	Rock Cafe	24	Rector Hardware Co.
37	Gulf Service	16	Marshall Dept. Store
29	Service Garage	22	Vacant
-	Methodist Church	17	Robert's Rexall Drugs
38	Esso Service		(Lower Bridge Street)
8	Tire Recapping	23	Leonard Home Appliances
	Southside, east to west:	34	Elam Farm Supply
-	Southern Railway Depot	18	Moore's Pharmacy
52)		28	Service Motor Co.
53)	Warehouse	47	Chandler Hardware Co.
9	Vacant	56	Redmon & Worley Motor Co.
42	Diner	69	Apartment building
15	Ice cream stand	40	International Truck Sales
55	Vacant	36	Frisbee's Gulf Service
39	French Broad Elec. Co-op., REA	54	Lighthouse Grill

*Residences are not numbered or listed.

TABLE 3--(Continued)BUILDING IDENTIFICATION FOR PLATE 9

UPPER BRIDGE STREET

<u>No.</u>	<u>Name</u>
12	Coal-Feed-Lumber Company
-	American Legion

LOWER BRIDGE STREET

70	Elam Farm Store
35	Taxi office
46	Vacant
68	Vacant
-	Sheriff's office and jail

north of the Marshall business district. The old Main Street route has been designated as U. S. Highway 25 and 70 Business. Tourist and truck traffic now misses the downtown section, and this may ultimately have a tendency to cause some businesses to move from the flood plain to the new highway location.

The commercial establishments now in the central business section include two banks, a milling company, a wholesale grocery firm, five automobile or truck agencies, two recapping firms, two coal, feed, and supply stores, four dry goods stores, two variety stores, two drug stores, three restaurants or diners, five service stations, a funeral home, an REA electric cooperative office, and numerous small offices. Only the Court House and one church have their floors higher than the elevation reached by the 1916 flood which is equivalent to the Regional Flood discussed in Section III of this report. The Maximum Probable Flood described in Section IV, would be 9 to 17 feet higher than the 1916 crest and would be well above these floors.

Basements throughout the business district are subject to flooding. Some of these contain only a heating plant, others are used for merchandise storage or work space. One contains a barber shop. Most of the basements have drains connected to storm sewers or leading directly to the river. Water can back through these drains into the basements. Those not equipped with drains are all subject to seepage.

A single story warehouse building on the left bank below the lower bridge is used by one of the automobile firms for storage. The floor level, elevation 1639.4 feet, is 7.9 feet under the 1916 flood crest elevation.

In the Rollins community near the upper corporate limit are located 3 bulk oil plants, the county school bus garage, and the REA supply yard, all subject to large floods. The REA warehouse building is at elevation 1657.5, the school bus garage is at elevation 1656.1 and offices of the three bulk oil plants are at elevations 1654.6, 1654.4, and 1656.1 feet. The 1916 flood crest was at elevation 1661 to 1667 through this reach, or from 5 to 10 feet over these floors. The Maximum Probable Flood is 10 to 12 feet higher than the one in 1916 in this vicinity.

Residences in the flood plain, in addition to those in the downtown business district, include 13 on the left bank opposite Blennerhassett Island and 10 in the Rollins community, plus several others at scattered locations. The 13 houses opposite the business section are frame dwellings at which the floor levels are all under the 1916 flood crest elevation by amounts ranging from one to eight feet. Floor levels at six of the houses at Rollins are under the 1916 flood elevation and they would all be flooded by a Maximum Probable Flood.

Blennerhassett Island and the Marshall School buildings are the first places to be affected by rising water at Marshall. The original school building is now the center one of three buildings on the island. High school classes are held in the basement and the two upper floors of this building. The basement floor is at elevation 1631 and the main floor is at 1642.5 feet. In 1952 the basement walls of this building were made more nearly seepage tight and the lower window openings were closed up to elevation 1637.4 feet. Small seepage pumps will probably protect the lower floor until water reaches the new window sill elevation. However, the building is surrounded well before this stage and the school must be closed down. At the newer building at the upstream end of the island, which houses grades 1 through 3 and the school cafeteria, the critical floor elevation is 1640.4. A basement for the heating plant is at elevation 1627.2 and is flooded when water crosses into a stair well

at elevation 1636.7. Downstream from the old building is the new shop and gymnasium building. The ground floor at elevation 1635 has shops and classrooms. The gym floor is at elevation 1646.6. Hence the first damage at the school occurs when water enters the shops at elevation 1635. At 1636.7 the cafeteria basement is flooded and at 1637.4 the basement floor of the main building is flooded. Basements are subject to earlier flooding by seepage or from water backing up drains. In the flood of August 30, 1940, water reached an elevation of 1644.1 feet, 1.6 feet over the main floor of the old building and nearly 4 feet higher than the floor of the cafeteria which has been built since that flood. In the gym building water would be 9 feet over the shop floor in a recurrence of the 1940 flood. The 1916 flood was about 4 feet higher than the 1940 flood at the school and a recurrence of that flood would put water over the gymnasium floor. The Maximum Probable Flood level is 13 to 15 feet higher than the 1916 crest in the vicinity of the school buildings.

At the left bank end of the upper bridge are buildings which have housed local industries in the past but are now largely unused. The Capitola Manufacturing Company operated a cotton mill there from 1905 to 1926. Electric power was sold beginning in 1928 when the Marshall Mill and Power Company took over the plant. Various firms produced textiles until about 1951. The Sorenson Bent Wood Products used the buildings for a number of years after that date. The French Broad Electric Membership Corporation purchased the hydroelectric installation in 1943. They remodelled the facilities and produced power until 1958. They now use the smaller building above the bridge for a meter service department. The floor of this building is at elevation 1648.8, slightly higher than the 1916 flood level. The larger building below the bridge has its floor at 1646.7 feet, 1.8 feet under the 1916 crest elevation. The Maximum Probable Flood elevation is 1664.8 at the upper building and 1663.6 at the lower one.

The single track of the Southern Railway originally was located back from the river's edge, on about the alignment of the present Main Street. When moved to its present location the track was first put on low trestles. Later a retaining wall was built and the trestle was replaced by a fill. A number of

culverts and storm sewers drain surface water through the railroad fill and wall. Two 60-inch concrete culverts with drop inlets drain surface water from behind the tracks in the center of town. One, located behind the REA Cooperative office, has an inlet elevation of 1637.9. Another, behind the Citizens Bank, has an inlet at elevation 1639.4. Sandbags have been used to prevent overflow of these drains by backwater on a number of occasions. Top of track elevation of the railroad is 1648.0 feet at the upper end of the business section dropping off to 1637.8 feet at the downstream end of town. The floods of July 1916 and August 30, 1940, were both well over the tracks through Marshall, and the Maximum Probable flood would cover them as much as 24 feet deep.

The sanitary sewer system of Marshall empties into the river below the business district. Flood stages high enough to back up through the sewers will have already caused flooding in the business section of town. The main line of the sanitary sewer system under Main Street is from 3 to 4 feet beneath the surface, higher than the basement floor elevations of those buildings fronting on Main Street.

A small stream having its source in springs on the hill above the business section runs beneath the Court House and Lower Bridge Street, and discharges through a culvert located beneath the right abutment of the Lower Bridge. Culverts under Main Street and Gudger Street connect with this culvert as part of the storm sewer system.

The source of Marshall's water supply is 4 miles north of the city in the headwaters of Hunter Creek, a tributary of Walnut Creek. Three storage reservoirs are located 1 mile north of the French Broad River on the hill overlooking the business section. A 6-inch line runs as far east as the Rollins district, and lateral lines cross the Lower and Upper Bridges to serve the school on the island and customers on the left bank.

The central telephone exchange is on high ground overlooking the flood plain.

Bridges Across the Stream

There are two bridges across the French Broad River in the reach considered. Table 4 lists pertinent elevations on these structures. Figure 2 shows the bridges at these locations immediately after the crest of the August 30, 1940, flood.

TABLE 4
BRIDGES ACROSS FRENCH BROAD RIVER
VICINITY OF MARSHALL, NORTH CAROLINA

<u>Mile Above Mouth</u>	<u>Identification</u>	<u>Low Water Elev. feet</u>	<u>Floor Elev. feet</u>	<u>1916 Flood Crest feet</u>	<u>Underclearance</u>		
					<u>Elev. feet</u>	<u>Above 1916 feet</u>	<u>Below 1916 feet</u>
125.09	Lower Bridge	1625.3	1650.1	1648.1	1647.0		1.1
125.21	Upper Bridge	1626.4	1647.8	1648.5	1646.4		2.1

The upper bridge at Mile 125.21 is a steel truss bridge which has recently been condemned and is closed to motor traffic. It has a floor which is at elevation 1648.0 feet at the left abutment, dropping to 1642.0 at the right bank abutment. The crest of the 1916 flood was 0.5 foot higher than the high end of this bridge. The bridge replaced an older bridge at this point which was destroyed by the 1916 flood, and the flood of August 30, 1940, carried away one span of the present bridge.

The lower bridge, at Mile 125.09, is of concrete and steel construction. It was opened to traffic in 1959 and replaces a steel truss bridge which in turn replaced one which had been partially destroyed by the 1916 flood. The bridge provides, by way of a connecting ramp, the only access to the Marshall School on Blennerhassett Island. The underclearance of the new bridge lacks 1.1 feet of being high enough to pass a flood of the magnitude of that experienced in 1916. The highest level of the bridge floor is at an elevation of 1650.1 feet, but at the right bank abutment the floor elevation is only 1641.6 feet. This latter elevation is about 3 feet below the crest of the August 30, 1940, flood and about 6.5 feet below

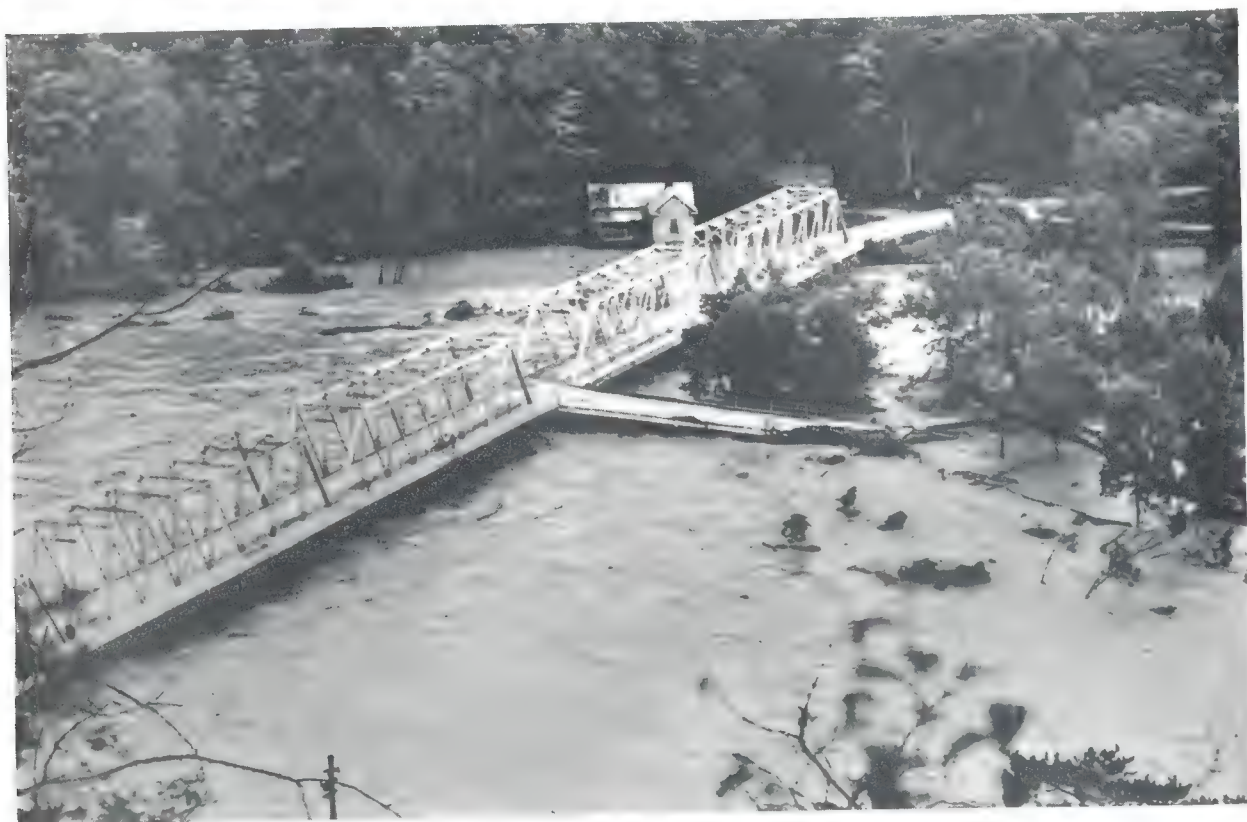


Figure 2.--MARSHALL BRIDGES DURING 1940 FLOOD

The top view, showing the downstream side of Upper Bridge, was taken at about 5:30 p.m., August 30, after the river had fallen 6 feet. Water overflowed the floor of the span on the left and debris caused the next span to fail at the crest which occurred at 5:00 a.m., August 30. The bottom picture taken by the Asheville "Citizen-Times" shows the old Lower Bridge, which was replaced in 1959. The picture was taken at 10:00 a.m., after the river had fallen 2 feet.

the crest of the July 1916 flood. A solid wedge-shaped pier at the head of the island protects the connecting ramp from destructive washing and diverts river flow into the two channels around the island.

Obstructions to Flood Flows

The extensive business and residential development in the Marshall flood plain substantially obstructs the flow of large floods in the French Broad River. As Plate 9 shows, the buildings on the right side of the river form an almost solid wall across the floodway from the normal river's edge to the steep slope at the edge of the flood plain. Buildings on the north side of Main Street extend to the foot of the slope and in a number of cases the back wall of the building is a retaining wall which is set into the slope. Many buildings on the opposite side of the street extend through to the edge of right-of-way for the railroad. Hence the only clear opening on the flood plain is along Main Street and the railroad. In the flood of August 30, 1940, a warehouse was washed from its site near the Southern Railway depot, carried several hundred feet down Main Street, and lodged across the street between the Presbyterian Church and the opposite building, effectively blocking this opening in the flood plain. Figure 6 shows this situation. Similar conditions could be experienced during a flood of the magnitude of the Maximum Probable.

There has been some filling over the years in the downtown area as buildings were added or altered. The railroad with its retaining wall has restricted the flood carrying capacity of the flood plain to some extent, as has the flume structure on the opposite bank. The buildings on Blennerhassett Island also restrict the flood flow.

Effect of Ice Jams

The Marshall reach of the French Broad River is affected at times by serious ice jams that choke the channel and create a hazardous condition. One of the earliest known of these ice jams occurred in about 1883 when the river froze over sufficiently to easily support a wagon and team. When the ice moved



Figure 3. --ICE JAM OF FEBRUARY 18, 1958, AT MARSHALL

The top picture was taken by an Asheville "Citizen" photographer on the morning of February 18. The bottom view is in the late afternoon. Both are looking upstream from Lower Bridge.

out the resulting jams blocked travel for some time on the river bank stage roads. At Hot Springs ice piled up to the bridge floor, 21 feet above normal river stage.

The winter of 1917-1918 was probably the most severe of record in the French Broad River area. Ice remained on the streams until late in January when it began to melt. Huge ice jams threatened Marshall and Hot Springs, according to the Asheville "Citizen" for January 29, 1918. The jam caused backwater on January 28 which covered the Southern Railway tracks upstream from Marshall.

On January 2, 1936, ice that formed during the cold weather of the preceding month moved down the French Broad River and jammed in the narrows below Marshall. Ice was piled 5 feet deep on the tracks of the Southern Railway just below town, blocking trains for several hours. Water was backed up through culverts into the streets by the jam for a depth of two feet in front of the Presbyterian Church, according to the Asheville "Times."

A similar ice jam occurred in January-February 1940, although there was no flooding at that time.

The most recent ice jam was that of February 17-20, 1958. This jam began forming on the night of February 17. By the next morning, ice had backed up past both bridges as shown in Figure 3. Water from the blocked river entered Main Street about mid-afternoon of February 18 as a result of the jam, reaching a depth of 2 feet at the low part of the street and stopping traffic for an hour or more. The lower end of Blennerhassett Island was flooded that evening. Flooding on Main Street occurred again for brief periods on the afternoons of February 19 and 20. The river was not clear along the Marshall reach until February 24.

It was fortunate that no heavy storms occurred on the watershed upstream during these periods of obstructed flow. Such a combination of events could produce a serious flood at Marshall.

Capitola Dam

The concrete dam at the upper end of the Marshall business district was built about 1920. A timber crib and rock dam built at the site before the turn of the century was seriously damaged in the flood of July 1916. The old dam was

owned by the Marshall Milling Company and was used in the operation of a flour mill. In 1905 Capitola Manufacturing Company began using some of the water power for their operation. After the 1916 flood the Capitola Company bought the dam and built the present structure. In 1943 the French Broad Electric Membership Corporation purchased the dam, added flashboards 2 feet high, improved the flume and added new power generating equipment. The plant has not been operated since 1958. No effort has been made to replace or repair damaged flashboards, and many of them are missing.

This dam is 680 feet long, averages 8 feet high and its axis is at an angle of approximately 45 degrees to the flow line of the stream. A flume extends 825 feet down the left bank. The crest of the dam is at elevation 1638.5. With flashboards in place the effective crest was at elevation 1640.5. At this elevation, backwater extends to river mile 126.2, or 0.2 mile above the mouth of Hayes Run.

Redmon Dam

Redmon Dam, a small hydro-electric installation owned by Carolina Power & Light Company, was completed in 1908. It is located at Mile 122.9, some 2 miles below the Marshall business district. At full pool and normal flow, backwater extends to about Mile 124.7, or just below the toe of Blennerhassett Island. Redmon Dam has little or no influence on the height of large floods in the reach considered in this report.

TVA Flood Protection Study

In 1941 and 1942 the TVA, at the request of a committee of citizens, industrialists, and agriculturists of western North Carolina, made an investigation of the flood situation in the Upper French Broad watershed and developed preliminary plans to provide protection against floods. Included in the over-all study was consideration of plans for local protection at Marshall. The results of this study were reported in a TVA publication "Flood Control for Upper French Broad River and Tributaries," August 1942.

Analysis of the flood situation at Marshall showed that, regardless of any flood control works built to protect Asheville and the upper watershed, Marshall

would still be endangered by floods arising from the nearly 400 square miles of watershed between Asheville and Marshall. The only complete salvation from floods for Marshall appears to be local protection works constructed at the town.

Such protection could be provided by a concrete levee wall which in general would follow the riverward side of the Southern Railway and would tie into higher ground at the two extremities of the town. The height to which the concrete wall would be carried could be varied, depending on the degree of protection desired and on the extent to which a flood control plan on the river watershed above Asheville was completed. For example, the wall might protect against floods of the size of August 1940 or against the greatest known flood of July 1916, or against some higher flood.

Construction of such a wall would require provision of structural steel gates to close openings at approach streets and the railway tracks. Local drainage from behind the levee during river flood periods could be ponded or removed by a small pumping plant. Automatic valves would be provided for present outlets to the river. The wall would not protect the school on the island or the mills and houses on the left bank of the river.

On the basis of costs and property values as of 1941, the benefits that would be realized from the necessary protection works were considerably less than the cost of the works. A re-examination of the problem under present conditions might show a change in the ratio of benefits to costs. No revision of the study has been made in recent years.

FLOOD SITUATION

PACK MEMORIAL PUBLIC LIBRARY
MARSHALL, NORTH CAROLINA

Flood Records

The U. S. Weather Bureau established a staff gage at the right end of the upper bridge at Marshall on March 10, 1902. It was discontinued in March 1903, and reestablished on December 1, 1917. Records of daily river stages were obtained from this date through March 1934. Regular daily observations were terminated April 1, 1934, but special observations during periods

of high water were continued, and these records are on file at the U. S. Weather Bureau Office in Asheville. Observations from August 22, 1934, to December 24, 1958, were made from a chain gage located on the downstream handrail of the lower bridge. After the old lower bridge was replaced by the present bridge, a wire-weight gage was established on March 26, 1960, on the downstream handrail of the new bridge, and flood period observations were resumed. Since October 1, 1942, the U. S. Geological Survey has maintained continuous records of stream-flow from a recording stream gage located at Mile 126.7 near the upper corporate limits of Marshall.

Data on floods in Marshall prior to gage records have been obtained from interviews with witnesses and local residents possessing a knowledge of the floods, from newspaper files of the Asheville "Citizen-Times" and the Marshall "Record," and from a search of historical documents and records. Reports of investigations made by the Hydraulic Data Branch during the last 25 years have supplied valuable data. Chief among these reports was one prepared by the Branch on the August 1940 floods.

Flood Stages and Discharges

Peak stages are given in Table 5 for known floods exceeding bankfull stage of 10 feet at the site of the upper bridge gage at Marshall. For the period December 1917 to March 1934 the peak stages shown are those observed at the gage. After April 1, 1934, peak stage observations at the lower bridge gage have been adjusted to the upper bridge site. Stages for floods prior to 1917 are based on previous flood height investigations made at Asheville and a stage relationship curve between the two locations. The July 16, 1916, crest stage is from high water marks.

Table 6 lists the 10 highest known floods in order of magnitude and gives the estimated peak discharges for three of the more recent ones. Discharges are at the U. S. Geological Survey gaging station, Mile 126.7

TABLE 5

FRENCH BROAD RIVER AT MARSHALL, NORTH CAROLINA

FLOOD CREST ELEVATIONS AND DISCHARGES ABOVE BANKFULL STAGE

1791-1960

This table includes all floods recorded since December 1, 1917, that exceeded bankfull stage of 10 feet. Prior to that time the records are necessarily incomplete. All stages are referred to the original gage site at the upper bridge, Mile 125.21. Drainage area at Marshall - 1338 square miles; zero elevation 1624.47, U. S. C. & G. S. 1936 Supplementary Adjustment.

Date of Crest		Gage Height		Date of Crest		Gage Height	
		Stage feet	Elevation feet			Stage feet	Elevation feet
April	1791	(a)		July	16, 1916	24.0	1648.5
August	1796	17	1641	January	28, 1918	10.5	1635.0
	1810	15	1639	October	25, 1918	10.3	1634.8
May	1845	17	1641	October	30, 1918	10.0	1634.5
August	1850	16	1640	August	16, 1928	16.3	1640.8
August	1852	18	1642	January	19, 1936	11.1	1635.6
March	1867	17	1641	March	28, 1936	11.8	1636.3
February	1875	11	1635	April	6, 1936	10.9	1635.4
June	17, 1876	21	1645	October	17, 1936	10.1	1634.6
October	17, 1879	11	1635	January	3, 1937	10.3	1634.8
June	1892	12	1636	August	14, 1940	14.5	1639.0
September	13, 1893	12	1636	August	30, 1940	20.3	1644.8
March	15, 1899	12	1636	December	29, 1942	10.2	1634.7
March	19, 1899	12	1636	January	7, 1946	11.6	1636.1
May	22, 1901	13	1637	February	10, 1946	12.4	1636.9
December	29, 1901	13	1637	June	17, 1949	12.1	1636.6
February	28, 1902	21	1645	March	23, 1952	10.4	1634.9
January	23, 1906	12	1636	February	21, 1953	10.1	1634.6
August	31, 1910	14	1638	January	22, 1954	10.9	1635.4
July	11, 1916	13	1637	January	31, 1957	10.7	1635.2
				April	5, 1957	13.4	1637.9

(a) Stage unknown.

TABLE 6

FRENCH BROAD RIVER AT MARSHALL, NORTH CAROLINAHIGHEST 10 FLOODS IN ORDER OF MAGNITUDE

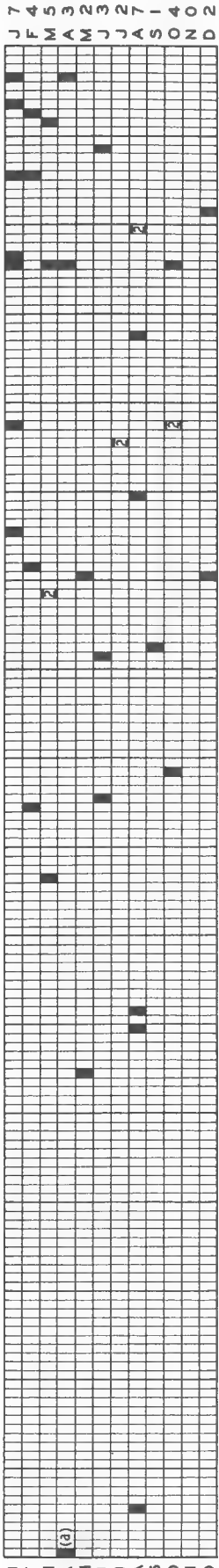
Order No.	Date of Crest		Gage Height		Estimated Peak Discharge	
			Stage feet	Elevation feet	Amount cfs	Per Sq. Mi. cfs
1	July	16, 1916	24.0	1648.5	115,000	86
2	June	17, 1876	21	1645		
3	February	28, 1902	21	1645		
4	August	30, 1940	20.3	1644.8	70,000	52
5	August	1852	18	1642		
6	August	1796	17	1641		
7	May	1845	17	1641		
8	March	1867	17	1641		
9	August	16, 1928	16.3	1640.8	45,000	34
10	August	1850	16	1640		

Flood Occurrences

Plate 2 shows crest stages and months of occurrence of known floods which have exceeded bankfull stage of 10 feet on the French Broad River at Marshall. The tabulation below shows the monthly distribution of the 20 floods occurring in the 42-year period of stream gage record between 1918 and 1960.

<u>Month</u>	<u>Number of Occurrences</u>	<u>Month</u>	<u>Number of Occurrences</u>
January	6	July	0
February	2	August	3
March	2	September	0
April	2	October	3
May	0	November	0
June	1	December	<u>1</u>
		Total	20

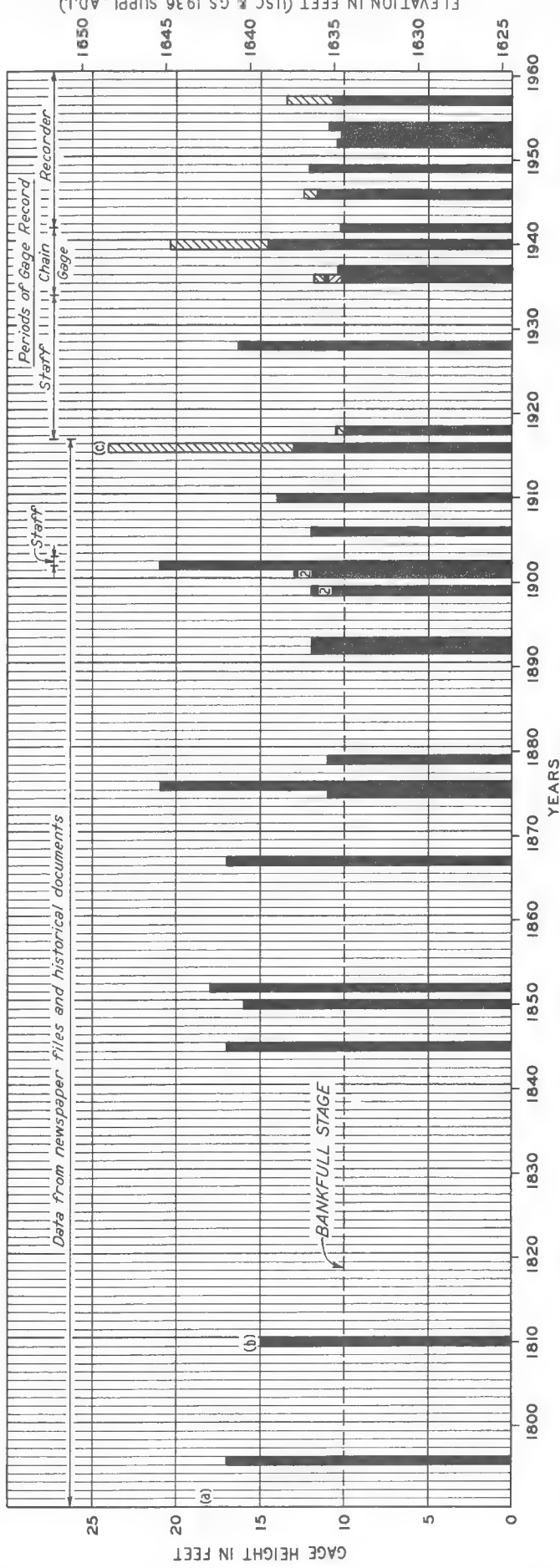
MONTH OF OCCURRENCE



NUMBER OF OCCURRENCES *

J 7
F 4
M 5
A 3
M 2
J 3
J 2
A 7
S 1
O 4
N 0
D 2

Data from newspaper files and historical documents



(a) Stage unknown in 1791.

(b) Month unknown.

(c) Stage based on high water marks.

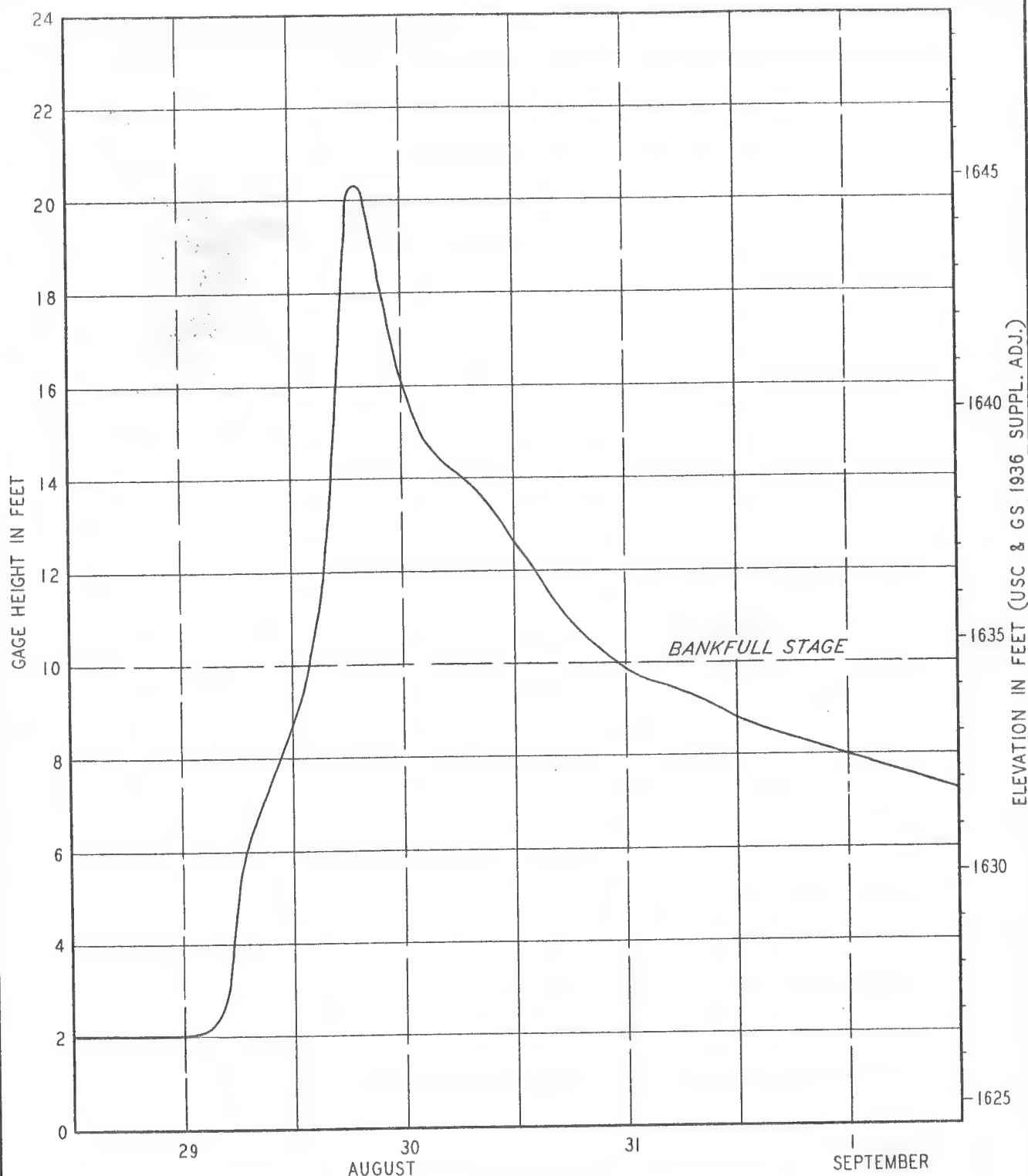
All stages are referred to gage at Upper Bridge - Mile 125.21

(*) Number of occurrences during 169 years, 1791-1960.

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

FLOODS ABOVE BANKFULL STAGE FRENCH BROAD RIVER AT MARSHALL, NORTH CAROLINA

MAY 1960



Gage heights at Upper Bridge, Mile 125.21.
Zero of gage is 1624.47 feet.

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

STAGE HYDROGRAPH
FRENCH BROAD RIVER
AT MARSHALL, NORTH CAROLINA
MAY 1960

If the incomplete data prior to 1918 are included, the record shows that floods above a stage of 10 feet have occurred in every month except November.

Although the greatest frequency of flood occurrences is in the winter months, the record shows that most of the higher floods occur in the summer months May through August.

Rate of Rise and Velocities During Floods

Plate 3 shows a hydrograph for the large flood of August 30, 1940, at the U. S. Weather Bureau gage at Marshall. Daily observations were made on this gage at and after the crest of the flood. The rising portion of the hydrograph has been closely estimated from continuous records of stream stages during the flood at Asheville and Hot Springs and on the Ivy River near Marshall.

During the late August 1940 flood at Marshall, the river rose from a stage of 2 feet to the crest of 20.3 feet in about 16 hours, or an average of 1.1 feet per hour. Although the crest stage came at 7 a. m. on August 30, most of the rise above the banks took place during the night hours. The river was above bankfull stage of 10 feet for about 33 hours.

Newspaper accounts of the record July 1916 flood indicate that the rise during that flood was even more rapid than in 1940. The chronology as reported in the "Madison County News-Record" for August 4, 1916, Plate 5, is as follows. All times are on July 16.

- 8:00 a. m. - "The river commenced to rise---"
- 9:30 a. m. - "--- it was overflowing the rock wall along the Southern Railway ---"
- 10:00 a. m. - "--- water was in Main Street ---"
- 12:00 noon - "--- everyone had --- taken refuge in buildings above Main Street. "
- Soon after 12 - "--- houses commenced to rise from their foundations and float down the river. "
- 4:30 p. m. - "--- The waters began to go down. "

On the morning of July 16, the river would have still been receding from the crest of the moderate flood on July 11 and would probably have been at

a stage of about 4 feet. Assuming that the crest stage came at about 4 p. m., the newspaper chronology indicates that the river rose from a stage of 4 feet to the crest of 24 feet in 8 hours, or at an average rate of 2.5 feet per hour. This would be more than twice the rate of rise in 1940.

During floods of the magnitude of the 1916 flood, average velocities in the channel of the French Broad River at Marshall would be in the order of 10 to 15 feet per second. In the flood plain through the city, velocities would be lower, perhaps in the order of 5 feet per second. During larger floods, velocities in the channel and in the overflow area would be greater.

Flooded Area, Flood Profiles, and Cross Sections

Plate 8 shows the approximate area in the Marshall vicinity that would be inundated by a recurrence of the July 1916 flood. Plate 9 shows the 1916 and 1940 flooded areas in the business section of Marshall. The limits of the 1940 overflow were outlined in the field immediately after the occurrence of that flood. The actual limits of the 1916 overflow on the ground may vary somewhat from those shown on the maps because the contour interval of the map, Plate 8, which is 40 feet, does not permit precise plotting of the flooded area boundaries. The commercial and industrial buildings shown on Plate 9 are indicated by a number on the map. Table 3 identifies these numbered buildings.

Plate 10 shows high water profiles on the French Broad River for the floods of July 1916 and August 30, 1940.

Plate 10 also shows profiles for the Regional Flood which is the same as the 1916 flood profile and for the Maximum Probable Flood which is discussed in Section IV of this report.

Plate 11 shows typical cross sections of the French Broad River and its valley at Marshall. The location of the cross sections is shown on the map and profile plates. Each cross section shows the elevation and extent of overflow of the floods of 1916 and 1940 and the Maximum Probable Flood. A number of cross sections, the locations of which are shown on the map and profiles, are not reproduced but are available from the Hydraulic Data Branch of TVA to anyone who has need for them.

FLOOD DESCRIPTIONS

Following are descriptions of known large floods that have occurred in the Marshall vicinity. These are based on newspaper accounts, historical records, and investigations by Hydraulic Data Branch engineers.

1791 to 1876

Flood history research carried on in connection with the study of flood control for the Upper French Broad River and tributaries showed that many large floods occurred in the early years of settlement in the Asheville vicinity. The earliest known of these floods occurred in April 1791. Information on this flood is credited to W. J. Alexander of Asheville in an article printed in the July 27, 1916, issue of the Asheville "Citizen." Mr. Alexander, who was born in 1830, was told by his grandfather of a flood in April 1791 on the Swannanoa River which apparently was as large as or larger than the one in 1916. It seems reasonable that a great flood also occurred at this time on the French Broad River at Asheville and Marshall.

Other historical floods occurred in August 1796 and in 1810. In May 1845, when Mr. Alexander was 15 years old, a flood covered all of the bottom lands but, according to Mr. Alexander, there was no loss of life. Floods occurred in August 1850 and August 1852. According to the Asheville "News" of September 2, 1852, the 1852 flood on the French Broad River "was higher . . . than it has been in many years before, exceeding largely the great flood two years ago."

The flood of March 1867 was the greatest known on the French Broad River at Newport, exceeding by 1.0 to 1.5 feet the floods of 1902 and 1916. Although this was largely a downriver storm, it undoubtedly produced a large flood also at Asheville and Marshall.

A moderate flood occurred late in February 1875 as a result of intense rainfall. The "Citizen" for March 4, 1875, reported that the rivers "rose so rapidly that persons residing along their banks had to abandon their houses and effects and flee for safety."

June 17, 1876

This flood, often called the "June Freshet," is one of the great floods in the upper reaches of the French Broad River. At Asheville it ranked next below the July 1916 crest among floods of the past 150 or more years. The Signal Service weather observer for Asheville described the flood there as follows:

The most prominent feature of this month was the large freshet on the 15th, 16th, and 17th. The height of the French Broad River in this and adjacent counties was higher than it is remembered by the oldest inhabitants. . . . The river was highest on the 17th noon, after having risen steadily the two days previous. . . . The oldest persons in the county cannot remember such a height of the French Broad, and several of them stated the river to have been 2 feet higher than ever before. . . . One man has been drowned at Marshall, Madison County.

An article in the Charlotte, North Carolina, "Daily Observer" for June 24, 1876, carried an account of the flood with the following reference to Marshall:

THE MOUNTAIN FLOODS--A young gentleman of this city who has just returned from the mountains, whither he went on a drumming expedition, brings a graphic account of the devastation wrought by last week's floods in the "Switzerland of America." He was water bound up there, and says it seemed as if the waters would move the everlasting hills themselves. Little bits of streams swelled into rivers, and rivers of insignificant width grew a mile wide. Much of the town of Marshall, the county seat of Madison, is built on an island, and the town was nearly all washed away. The jail went away on the bosom of the troubled waters, and had a good deal of company. . . .

February 28, 1902

This was one of the greatest known floods at Marshall. The following article from the Asheville "Citizen" for March 1, 1902, indicates a crest stage comparable to those of 1876 and 1940:

MARSHALL NEARLY SWEEPED AWAY BY FLOOD
 DAMAGE TO BUILDINGS AND STOCKS SHOOT UP INTO THOUSANDS OF DOLLARS
 NO TRAINS WEST FOR DAYS
 MURPHY BRANCH STILL TIED UP, WHILE DAMAGE TO ROADS IS SERIOUS

All communication to points west of Asheville is still cut off. At Marshall it is said the greatest apprehension was caused for fear the entire village would be swept away. The high wall traversed by the railroad tracks, separating the long narrow one street town from the river, was out of sight under the flood. A number of buildings were completely washed away and dozens of others undermined from their foundations. Horses, carriages, and other property were carried down with the current of the tide. A number of freight cars that were on the switch at the depot were floated away. Freight and express were also carried off by the flood and the people of the little village were almost panic-stricken for fear that all would be lost.

A number of residents of Marshall made their way here on foot and gave an account of the situation in their town. They also reported that the railroad tracks for miles are washed away and that telegraph and telephone wires are strewn all along the river banks.

Among some of the losses reported are:

Rector Hotel, almost all personal property and hotel furnishings washed away; loss not known.

Carolina Mineral Company, loss \$2,000.

Whites Livery Stable, horses, carriages, personal property, loss \$1,500.

J. J. Perkins entire stock of goods.

Pritchard & Rollins, library, valued at \$2,000.

J. M. Buck Lumber Company, 2,000,000 feet of lumber.

J. W. Nelson & Co., buildings and goods, \$1,500.

James Hensley barn, granary, and 2 mules.

W. B. Ramsey residence wrecked.

The damage to the Southern Railway is incalculable. Miles of track in all directions are washed away and a number of valuable bridges gone. It will perhaps be some time before an estimate of the damage done will be known.

July 16, 1916

This was the greatest known flood on the French Broad River in North Carolina. It resulted from a tropical hurricane storm that passed inland over Charleston, South Carolina, on July 14 with winds of near hurricane intensity. The storm center advanced northwestward across South Carolina, losing much of its surface intensity but maintaining its intensity and high moisture content in the upper levels. Its path was affected by a high-pressure area over the northeastern states, and the heavily moisture-laden storm was directed toward the highest portion of the Blue Ridge which it was unable to cross because of insufficient energy.

The heaviest rainfall during the storm occurred along the Blue Ridge, particularly along the eastern boundary of the upper French Broad River watershed. Plate 4 shows the rainfall distribution over the watershed. Altapass, North Carolina, recorded 23.7 inches for the storm, with 22.2 inches of this amount falling in 24 hours. Rainfall amounts decreased rapidly to the north and west of the Blue Ridge, and the Marshall area received only about 3 inches.

The story of this great flood at Marshall was graphically told in the August 4, 1916, edition of "The News-Record," published at Marshall. Plate 5 is a reproduction of the first page of this newspaper, and Figures 1 and 4 show the effects of the flood.

The following story on the effects of the flood is from the Asheville "Citizen" of July 18, 1916:

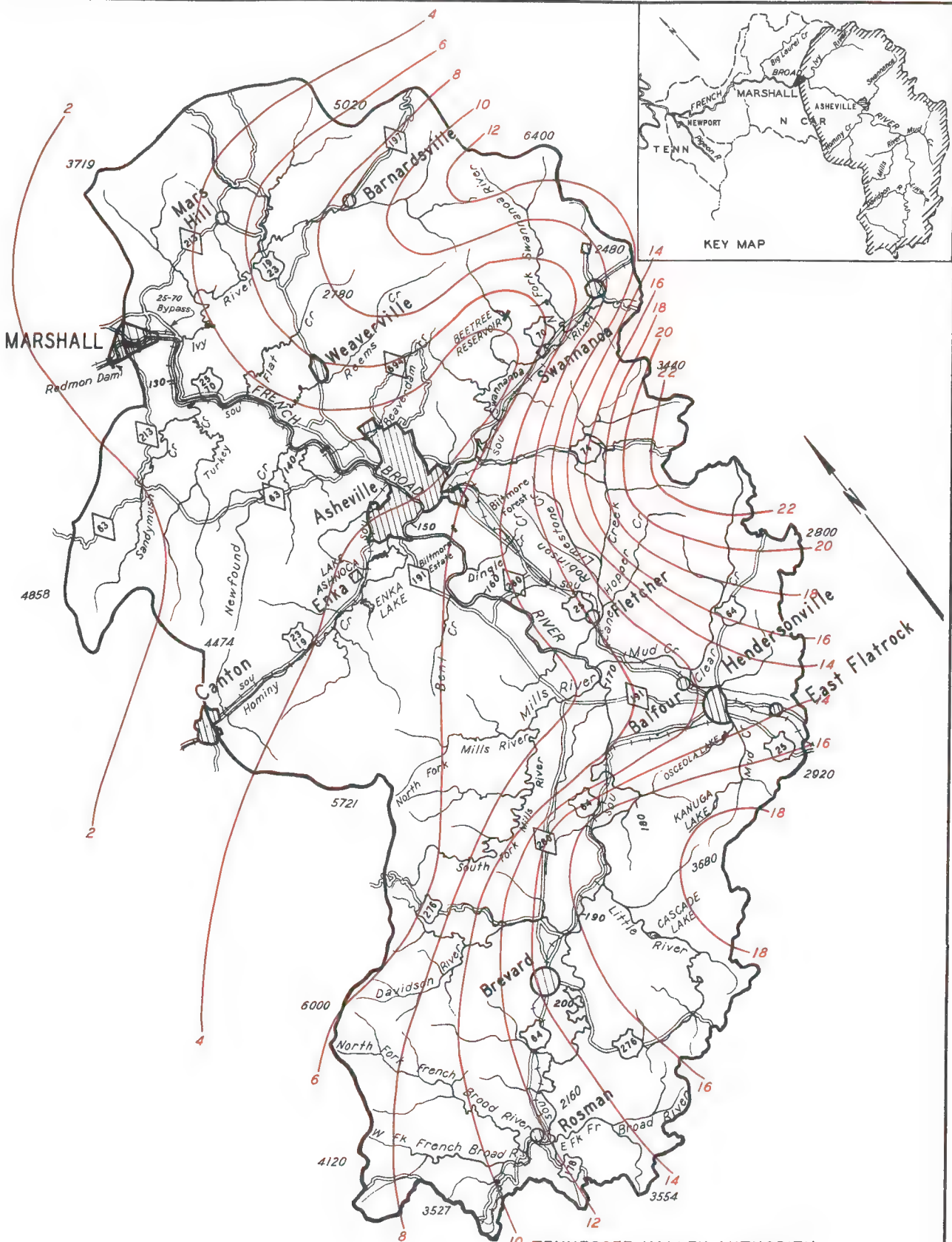
MARSHALL HARD HIT BY THE FLOOD: DEATH LIST THREE

The little town of Marshall which is built with its back to the mountains and has the French Broad River for its front yard, has felt the full force and fury of the flood.

The waters exacted a toll of three lives from the town as it swept down the river in all its ungovernable fury, and the tales of sorrow and suffering among the people there are many.

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The property loss is not known, but that it will reach big figures goes as a matter of course. The town has but one street, and that faces directly on the river, and is but a very few feet from its waters.



~ 10 ~ INCHES RAINFALL

Scale 0 5 10 Miles

10 TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

UPPER FRENCH BROAD AREA
SHOWING
JULY 1916 ESTIMATED STORM RAINFALL

MAY 1960

 * MADISON COUNTY *
 * RECORD *
 * Established June 28, 1901 *
 * FRENCH BROAD *
 * NEWS *
 * Established May 16, 1907 *
 * Consolidated Nov. 8, 1911 *
 * *****

THE NEWS-RECORD

 * THE MEDIUM *
 * Through which you *
 * reach the people of *
 * Madison County *
 * ——— *
 * ADVERTISING RATES *
 * ON APPLICATION *
 * *****

THE ONLY NEWSPAPER PUBLISHED IN MADISON COUNTY

VOL. XVIII

MARSHALL, MADISON COUNTY N. C., FRIDAY, AUGUST 4th, 1916

NO. 31

French Broad Overflows Marshall; Two People Drowned

\$125,000 Worth Of Property Destroyed; Bridges Washed Out

Heroic Efforts Of Many Are Praised; Citizens Are Optimistic

ON SUNDAY, JULY 16

The river commenced to rise at about 8 o'clock a. m., and at about 9:30 a. m., it was overflowing the rock wall along the Southern Railway Track. At 10 o'clock the water was in Main Street and the people living along the street were carrying to places of supposed safety such of their household goods as they could get out. Many people carried their furniture into the upper stories of their buildings. At 12 o'clock everyone had crossed the street and taken refuge in buildings above Main Street. The water came down with tremendous force carrying with it the evidences of the great destruction that was taking place along its course.

Houses, logs, lumber, barrels, boxes, bridges, all were carried away. The old bridge at Bridge Street here gave away and nothing of it was left save the rock piers upon which it had rested for many years. Above the first span of the new bridge a drift that reached for more than one hundred feet up the river, gathered. The structure held off probably an hour but the pressure of current and the drift proved more than it could stand. Three spans of this bridge were broken loose but all of them lodged close and will be taken to pieces and put back. Two of the concrete piers were lost. The current cut a great channel through the island.

An immense drift gathered at the east end of the Southern depot and turned a current against the houses on the North side of the street in that section of the town. Soon after 12 o'clock houses commenced to rise from their foundations and float down the river. The sight was one that cannot soon be forgotten by those who witnessed it. On either side of the river great crowds of people gathered watching the destruction that was being wrought. Perhaps three millions of dollars worth of property came down the river during the day. Men and women in Marshall whose homes and property were being destroyed stood the strain with a nerve and courage as fine as was ever displayed, under such trying conditions. No one wept but all appeared stout hearted and cheerful.

At 4:30 o'clock p. m., the waters began to go down and at the Baptist Church where many people had gathered a short prayer service was conducted by Rev. S. T. Hensley.

Homeless People Cared For

Stout-hearted and cheerful, Messrs. J. H. White, Dr. Frank Roberts, Jno. A. Hendricks, James West, Nat. Calombe, Guy V. Roberts, R. H. Cotton, E. B. Gilbert, Posey Fisher, John Jarrett, Reuben

Rainsey, J. C. Ramsey, E. R. Tweed, P. V. Rector, Rev. S. T. Hensley, and others living on the hill opened their homes and, in fine style cared for those who had been driven from their home by the flood. A good dinner Sunday and lodging and meals until the waters had gone down were provided by these good gentlemen and their wives. People in the surrounding community also opened their homes and displayed a most generous spirit toward those who were temporarily homeless.

Death List

Only two people lost their lives in the flood. They were as follows: James Guthrie and Miss Estelle Briggs. Both bodies were recovered on Monday and brought to the Baptist Church where they were prepared for burial. It is stated that both Mr. Guthrie and Miss Briggs had left the house and gone to places of safety but later, thinking there was no danger, returned to the house and when it began to move they became frightened and, in trying to make their escape were lost. They were in the Ball & Gudgey Restaurant at the depot.

Washed Away

Quite a number of buildings were washed away. The following is a list:

Southern Railway pump house at depot, two tenant houses at depot owned by Ball & Gudgey, Livestock stable at depot owned by Ramsey & Rector, Erre Bailey's two houses, Erre King's building on Bridge Street in which was located the Central Telephone Office, H. L. Banks & Company's Store, Posey Fisher's Pressing Shop and Alfred Lowe's home, coal bins and cotton house owned by Capitola Manufacturing Company, Rector & Ramsey lumber plant, stable, tenant house owned by J. G. Ramsey, tenant house owned by Citizens Bank, stable and garage owned by C. B. Mashburn, Reuben Ramsey's warehouse owned by F. Shelton, small garage owned by Mrs. Claude Allison, stable, wood and coal house owned by Mrs. Nanney, corn crib owned by Barnett Fortner, Marshall woodworking plant owned by J. J. Redmon and Son and a dwelling house between the river and railroad just below the old church at West end of town.

Flooded

Every building on Main Street except the residence of P. A. McElroy, the Court House and the Baptist Church were flooded and filled with mud. Household furnishings and merchandise in the homes and stores were badly damaged. Windows in many places were smashed and porches were broken loose from some of the resident buildings along the street. A few buildings were moved from their foundations and left close by. A few others floated for some distance but lodged

against other buildings.

Damages

No one can, at this time, give an accurate statement as to the damage sustained by the town. However, a rough conservative estimate figures, in round numbers, a total damage of \$125,000.00 sustained by citizens of the town, aside from this the Southern Railway and Madison County have been heavily damaged. No bridges along the river in this county are left.

Clearing The Wreck

On Monday morning when the people came down to their homes only a small part of Main Street in front of the Baptist Church was visible. The street was full of drifts and presented a most forlorn appearance. But everybody went to work and gradually the street has been cleared of the rubbish, dwellings and business places have been cleaned up and the town is again becoming alive.

Convicts Used On Streets

Captain H. T. Peoples of the State Convict Force here brought down his force of men and worked on the street for three days.

Mr. Peoples is a splendid fellow and his services, at this time, places Marshall under lasting obligations to him. Aside from this, Mr. Peoples and his guards and assistants came to our relief with cash and provisions.

Mr. Robert Tweed, in charge of the county convicts, has also done telling work for us on our streets and is deserving of our deepest gratitude for his much-needed assistance. Captain Tweed continued working his men here for several days and has done a large amount of work in helping to clear away the wrecks.

Contributors To Relief Of Marshall

No one can tell just how many people and who they are that have contributed toward the relief of our town. The following, however, is a list who have contributed in cash and provisions through Rev. S. T. Hensley, who has been in charge of the relief work. Many others whose names do not appear on this list have made substantial donations to persons in need of help:

W. S. West, Z. R. Merrell, J. M. Ramsey Sr., A. F. Sprinkle, Jno. A. Hendricks, Mary Hill, Mamie Morrow, Jno. Knight, H. T. Peoples, W. W. Douden, Tobe Hodge, N. L. Smith, A. L. Edmunson, D. Rhymer, J. C. Rhymer, Willie Parker, D. W. Stewart, Edward Willis, S. B. Pfister, H. M. Pritchard, Z. G. Sprinkle, D. S. Tweed, W. J. West, Laura Ramsey, S. E. Tweed, W. E. Ramsey, Polk Bryan, Jack Bryan, Mrs. J. Wright, L. M. Ryan, Clarence Gage, J. F. Bryan, D. M. Golden, T. A. Silver, R. C. Eller, Jesse Fisher, Rev. L. C. Roberts, J. W. Roberts, W. A. Kent, W. R. White, Mrs. Belle Kent, Mrs. Belle Runion, Mrs. A. J. Runion, Nora West, May West, Mrs. T. B. West, L. D. Edwards, Lydia McClure, J. E. Bryan.

One of the greatest needs of the town was to get the streets and roads open for traffic. To aid us in this respect the following is a list of men who came

with wagons and teams to help us. Many gave their services in helping to clear the streets and clean out buildings whose names we do not have. We are grateful to all who came to our relief in any way and if we are not publishing a full list it is because we have been unable to get it complete.

W. B. Ramsey, 1 day; R. C. Rector, 2 days; J. F. Sprinkle, 3 days; Jasper Rice, 1 day; Will West, 1/2 day; Z. G. Sprinkle, 6 1/2 days; Jeff Runion 2 days; Bud Stines, 4 days; Alfred Sprinkle, 2 days; W. L. George, 1 day; J. E. Burnett, 1 day; W. L. Runion, 1 day; C. H. Runion, 1 day; J. C. Hutchins, 2 days; E. Y. Tison, 2 days; L. L. Edwards, 1 day; Wm. Edwards, 1 day; Prof. R. L. Moore, 1 day; R. S. Gibbs, 1 day; Clarence Gage, 3 days; Doug Tweed, 2 days; C. B. Mashburn, 2 days; Z. R. Merrell, 1 day.

We are deeply indebted to all of these good people for their timely help.

Marshall Dark

For several days after the flood Marshall was in total darkness. The lights came over a part of the town on Saturday night following the flood. The lighting, water and sewer systems have not yet been fully repaired but the work of repair is going forward rapidly and the town will again soon have plenty of both light and water.

Marshall Cut Off From Other Points

The high water put all telegraph and telephone lines out of commission and Marshall was off from communication with the outside world. The telegraph line, however, has been repaired, but all telephone lines are yet out of order. All railway traffic and mail service was completely stopped. Mail destined to Marshall was delayed for several days. Mail coming in from the west was delivered here last Sunday on a freight car. Postmaster Swann has brought mail up from Runion once or twice by automobile. The Southern Railway Company has been working a large force of men getting its track again in shape for traffic but up to date no passenger trains have passed through Marshall. A few passengers coming from the West have been delivered on work trains at the west end of town. Freight traffic over the line through Marshall is expected to begin within a few days. Passenger service will not begin until the track is put in a safe condition which will probably take several days.

Business Conditions

No one will deny that our town has sustained a heavy blow but the business men who were damaged are men of sterling character, ability and energy and will soon be doing business as before the flood. Marshall has always been a thrifty town and within a short time business here will be good. Any spot of earth in Marshall can be sold today at a good price.

Housekeeping

Housekeeping for the first two weeks after the deluge was a

rather difficult proposition, but the women of Marshall who, on Monday morning, found their homes full of mud, now have clean floors. The fires in the cook stoves have been relighted and homes that were full of mud and water on Sunday are now in good shape. The transformation has been great. Our ladies have shown a most splendid and commendable spirit. Throughout the days of disaster, toil and labor, they have been cheerful and buoyant. It is always the woman's spirit that shines brightest, the woman's love that never falters, in the midst of disaster and ruin. All honor to Marshall's brave, noble women.

Thieves

Quite a number of people have been caught carrying away shoes and other articles of merchandise. Some have been made to bring the goods back.

Glad Of Marshall's Misfortune

We have heard of a few people expressing their joy that disaster had befallen our town. Our country is more unfortunate in having a citizen of this type than the town was in being hit with the flood. We pass this fellow up by placing him in a class with thieves who stole from our people when they were helpless. We would be glad to get a list of these fellows and to publish their names.

Carolina Special

The Carolina Special going east and carrying aboard 200 passengers, was held up by the high water at Nocona, a few miles below Marshall. The train had sufficient food to last passengers and crew until Tuesday. Afterward supplies were carried in from the country and many of the passengers were kept by the farmers in the surrounding community.

Barnard

The bridge, a store, and a dwelling house, we are informed, were washed away at Barnard.

Hot Springs

Hot Springs was not seriously hurt. The bridge there across the French Broad was washed away and the Mountain Park Hotel was flooded.

Rollins

Quite a little damage was done at Rollins, just above Marshall. Several houses were damaged and a good bit of lumber was swept away.

OTHER PLACES ARE DAMAGED

The same flood that visited Marshall hit other places, washing away homes, crippling businesses and destroying property of immense value. Asheville and Buncombe County, it is said, sustained a loss of \$5,000,000. Biltmore, Craggy and Alexander were seriously damaged.

EDITORIAL

E. ZEPH RAY, Editor

J. H. WHITE, Business Manager

Cause Of The Flood

We have heard of a few people who have ventured their opinions as to the cause of the flood. A preacher who is alleged to have sold his vote in the primary election thinks the Lord sent the flood on Marshall because of the fact that a moving picture show was being operated here. A second holds the view that the Lord wanted to run a particular individual out of town. A third says the Lord was holding an equalization board, while the fourth thinks it was sent on us to punish certain individuals for building roads and bridges in the county. The community is fortunate in having men who possess such broad views and such deep thinking facilities upon moral and religious questions. We have not yet heard why the Lord at the same time, sent the flood on Asheville and so many other places. Should the information be in hand at any time we shall be glad to hand it out.

Governor Craig Calls On Marshall to Aid Flood-Stricken

We have been informed that a telegram from Governor Locke Craig has been received by Mayor Gilbert of Marshall, calling on the people for aid on behalf of flood-stricken people in the state. The Governor is to be congratulated for his activity on behalf of those made homeless and helpless throughout the flood. But Marshall has all she can do to take care or the suffering in her own borders. There is much to be done here, so that it will tax, to the limit, our energy and ability.

Freight And Passenger Traffic Resumed Over Southern Railroad

Freight and passenger traffic over the Southern have been partially resumed between Asheville and Knoxville. Passenger trains No. 11 and 12 operated on Thursday of this week. The track is not yet in condition for trains to make the old schedule. It is expected that within a few days all trains will again be in operation on this division. A large crowd of people assembled at the depot Thursday p. m., to welcome the arrival of passenger train No. 11, which was the first passenger train to reach Marshall since the flood. Soon after No. 11 had passed the block here No. 12, rolled slowly up to the station. Both trains were loaded to the limits with passengers. No. 11 was about two hours making the trip down the river from Asheville. These trains carried two wagon loads of delayed mail destined to Marshall and other points in Madison County.



Figure 4. --DESTRUCTION BY 1916 FLOOD AT MARSHALL

The top view west along Main Street from above the depot shows debris of destroyed buildings. The building in the middle of Main Street was washed from the present site of Teague Milling Company (formerly City Milling Company). The track had been repaired when the picture was taken. The lower view is west from the depot. Two residents were drowned at this location during the flood. (Photos by Southern Railway Company)

When the flood of Sunday was at its height, eye-witnesses say that the waters swept down that one street like a tidal wave, eight feet and more in height, and that it took everything movable in its path.

There were fifty-eight houses swept away, and with them went the three known to be dead. All the stores were damaged, in many cases the entire contents being taken by the flood. A part of Rector's Hotel was torn away and sent crashing against the rocks. The water came onto the steps of the courthouse, and the county jail was isolated. The prisoners, it is said, were taken to safety before the building was surrounded by the flood.

Drowned in Flood

James Guthrie, and Miss Bridges, his sister-in-law, were in the restaurant owned by Mr. Guthrie when the waters came upon the town. Before they had a chance to escape to the safety of the hills, the frame building was afloat on the very crest of the flood, and the two were seen to fall from the little structure and into the boiling waters of the angry French Broad.

.

M. L. Church of Asheville says that both the old and the new bridges at Marshall have gone out. . . .

Also given in the "Citizen" is the following eye witness account by Levis Foster, an Asheville man who was in Marshall on the Sunday morning of the flood:

"I left Marshall at 10 o'clock on Sunday morning," said Mr. Foster. "Most of the people had then gone up on the mountain for safety, and the waters were roaring down the street of the town with ungovernable fury. I could see house after house lifted bodily from their foundations, float slowly for a minute or two, and then suddenly be swirled into the current of the river. There must be between fifty and sixty of Marshall's buildings destroyed, and the merchandise in all the other stores must be ruined. In some cases the buildings stood the effects of the water, but all their contents were swept into the current. The brick buildings are standing, and the courthouse is safe. The two bridges are gone. . . ."

August 16, 1928

This was one of the major floods at Marshall and the first that substantially exceeded bankfull stage in the 12 years after 1916. The Asheville "Citizen" of August 17, 1928, described it as follows:

MANY HOMES FLOODED AT MARSHALL

Marshall, N. C., Aug. 16--Many homes were flooded and business men were moving their stocks of merchandise from ground floors of storehouses today to escape the slowly rising flood waters of the French Broad River which at one today had risen to approximately 8 feet of the high water mark of July 16, 1916.

Several families living in the eastern section of town, the area suffering loss from the flood, had removed their household furniture to higher ground. Part of the state highway was under water for a mile down the river from Marshall and it was believed that part of the roadbed had been undermined. The new \$95,000 school building was partly flooded, the basement and first floor being inundated.

Trains from Asheville this morning were forced to stop at Rollins, a station one mile east of here. For the first time in many years the Asheville Citizen was not delivered to subscribers in Marshall.

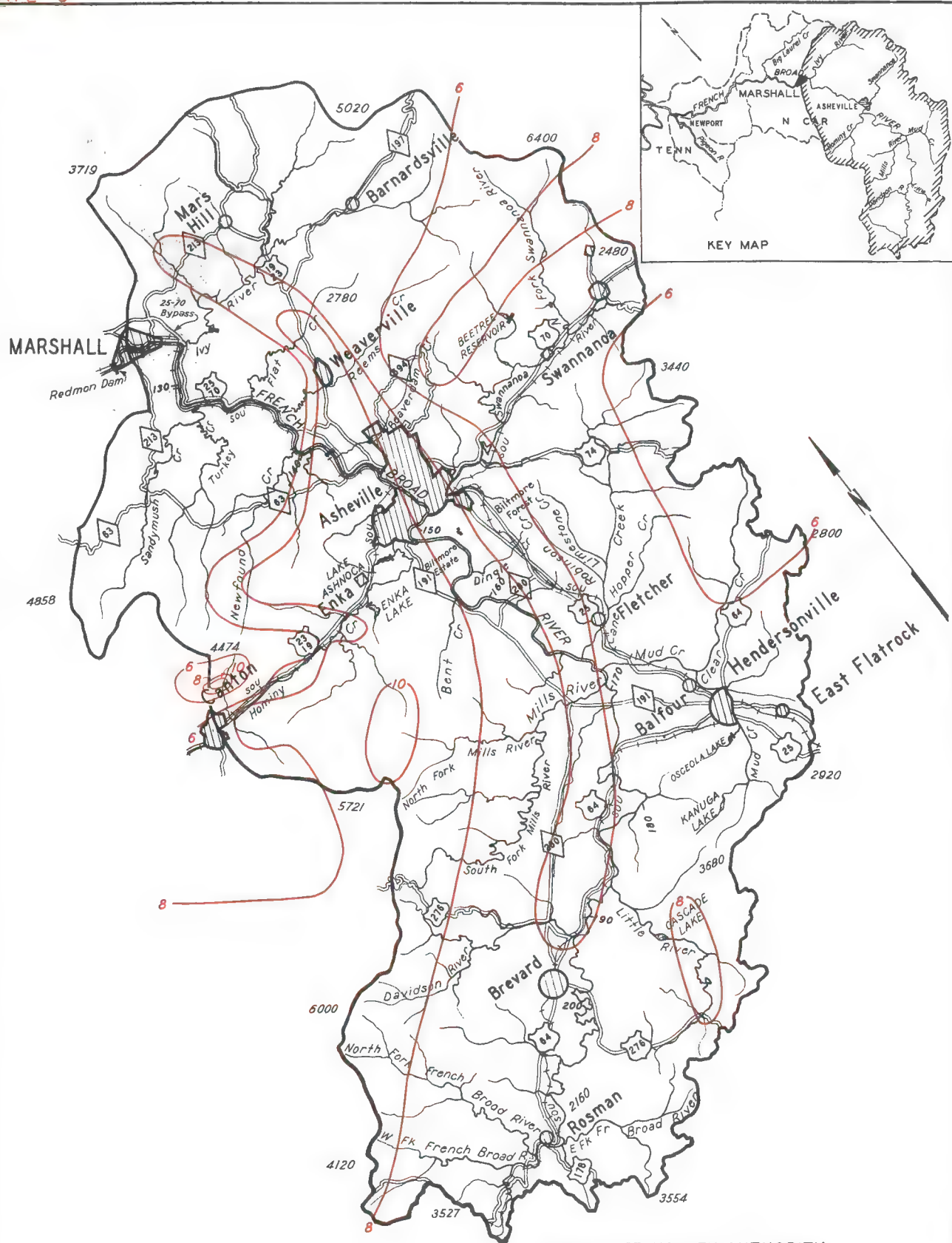
It is probable, officials state, that railroad service into Marshall will be crippled for several days, sections of the track being under from 4 to 6 feet of water.

August 30, 1940

Two large floods occurred on the French Broad River at Marshall in August 1940. The first on August 14 overtopped the masonry wall, overflowed the tracks of the Southern Railway in the lower part of town, inundated a portion of Main Street, and flooded a theater building and the basements of 11 stores. The basement and yard of the school on Blennerhassett Island were also flooded.

The second of the two floods, on August 30, ranks as the fourth highest known at Marshall. The flood resulted from intense thunderstorm activity which developed over the Southern Appalachian Mountains and which produced 24-hour rainfall amounts that exceeded 10 inches in some parts of the French Broad River basin. Plate 6 shows the storm rainfall distribution over the basin.

Very heavy runoff came during this flood from the 393-square mile tributary area between Asheville and Marshall. In July 1916 the inflow from this area added only 4 or 5 percent to the crest discharge at Marshall over that at Asheville. On August 30, 1940, the crest discharge at Marshall was increased 100 percent over that at Asheville by this local area flow. The highest stage and



~ 10 ~ INCHES RAINFALL

Scale 0 5 10 Miles

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

UPPER FRENCH BROAD AREA
SHOWING
LATE AUGUST 1940 STORM RAINFALL

MAY 1960

flow at Marshall came at 7 a. m. on August 30, some 5 hours before the crest at Asheville and less than 2 hours after the crest on the Ivy River, a major contributor to the local area inflow.

The late-August overflow in the Marshall business district covered an area very nearly the same as in July 1916, although flood depths were 2 to 4 feet less than during the 1916 flood. Water reached a depth of 7 feet in the low portion of Main Street. Forty-five business firms were flooded, the Southern Railway depot and the Gudger warehouse were washed from their foundations, and many houses were flooded. On Blennerhassett Island, water reached into the second story of the school building. The Southern Railway tracks were washed out for about 1,000 feet through the town. More complete descriptions of these storms and floods are given in the TVA report "Floods of August 1940 in Tennessee River Basin ."

Figures 5 to 11 show conditions in Marshall during and after the August 30, 1940, flood.



Figure 5.--MARSHALL BUSINESS PLACES FLOODED IN 1940

The Coal Feed and Lumber Company on the east side of Upper Bridge Street was flooded to depths of 15 to 48 inches on August 30, 1940. The water level in the French Broad Chevrolet Company's salesroom and garage was $3\frac{1}{2}$ feet deep at the crest stage. These views were taken at 4:45 p.m., August 30, after the flood had receded about 3 feet in the street.



Figure 6.--BUILDING DAMAGE IN 1940 FLOOD

The Madison Farmers, Incorporated, building on the south side of Main Street, top view, was heavily damaged by drift. The 1940 flood at the crest was 7 feet deep in the street. The bottom view, looking east along Main Street, shows the Gudger warehouse lodged in the street near Builders Supply Company. This two-story wood and metal structure, which withstood the 1916 flood, was carried about 300 feet by the 1940 overflow. (Lower photograph by Asheville "Citizen-Times")



Figure 7.--HOTEL AND HOME DAMAGE IN 1940

The 1940 floodwaters were almost 5 feet deep in the French Broad Hotel, top view, causing heavy damage to furniture and demolishing the large porch in the front. In the lower view, the D. A. Robinette home, located at the upstream end of the business section, was one of 35 houses flooded in 1940. At the crest stage, water was 3.1 feet above the floor. (Lower photograph by Asheville "Citizen-Times")



Figure 8. --CLEANUP AFTER 1940 FLOOD

The top view, taken at 6:00 p.m. August 30, is looking west down Main Street from the vicinity of the City Milling Company and the Southern Railway depot. The Gudger warehouse was located just beyond the depot. The bottom view shows silt on the porch of the Rector Hotel which was flooded to a depth of about 5 feet.



Figure 9. --SOUTHERN RAILWAY DEPOT AFTER 1940 FLOOD

These two views looking east show the heavy damage to the Southern Railway's Marshall Depot and tracks on August 30, 1940. At the crest stage, water was 4 to 5 feet deep over the tracks and velocities were very high.



Figure 10. --SOUTHERN RAILWAY DAMAGE IN 1940

The top view looking downstream toward the Upper Bridge shows the heavy track damage caused by the high velocity flow of the French Broad River on the left. The bottom view shows Southern Railway track crews already at work on repairs with flood waters still around them. (Photos by Asheville "Citizen-Times")



Figure 11. --RAILROAD TRACK DAMAGE IN 1940

Over 1000 feet of Southern Railway track were washed over the retaining wall and into the raging French Broad River by the August 1940 flood. The top view is looking upstream from below the depot. The bottom view is upstream from above the depot.

III.

REGIONAL FLOOD

Tennessee Valley Authority
Division of Water Control Planning
Hydraulic Data Branch

III.

REGIONAL FLOOD

Large floods have been experienced in the past on streams in the general geographical and physiographical region of Marshall, North Carolina. Heavy storms comparable to those that caused these floods could occur over the French Broad River watershed. In this event, floods would result on the French Broad River comparable in magnitude to those that occurred on the neighboring streams. Floods of this size are designated as Regional Floods. It is therefore desirable in connection with any determination of future floods that may occur on the French Broad River, to consider floods that have occurred on streams in the Marshall region on watersheds whose topography, watershed cover and physical characteristics are similar to those of the French Broad River.

Maximum Known Regional Floods

Table 7 lists the maximum known floods experienced on watersheds comparable to the French Broad watershed and generally within 100 miles of Marshall. This necessarily limits the watersheds considered to those whose headwaters lie in the Appalachian Mountain region, and eliminates watersheds to the west and northwest that lie entirely within the Great Valley. Streams which differ significantly in watershed characteristics from those of the French Broad River are not included.

One of the earliest great floods that occurred in this region was that of March 1867. This was the largest flood known along the lower French Broad, Holston, and Little Tennessee Rivers and the upper half of the Tennessee River. Rainfall in the order of 12 to 14 inches is estimated to have fallen over a period of several days on the Little Tennessee River Basin, while the French Broad watershed experienced an estimated 8 to 9 inches.

TABLE 7

MAXIMUM KNOWN REGIONAL FLOODS

FRENCH BROAD RIVER AT MARSHALL, NORTH CAROLINA

Map Reference No.	Stream	Location	Drainage Area Sq. Mi.	Date	Peak Discharge	
					Amount cfs	Per Sq. Mi. cfs
1	South Fork Holston River	at Kingsport, Tenn.	1935	May 22, 1901	110,000	57
2	Little Tennessee River	at Calderwood, Tenn.	1862	March 1867	150,000	81
3	French Broad River	nr Newport, Tenn.	1858	March 1867	110,000	59
				February 28, 1902	101,000	54
				July 16, 1916	97,000	52
4	Nolichucky River	nr Morristown, Tenn.	1679	May 1901	85,000	51
5	French Broad River	at Hot Springs, N. C.	1567	July 16, 1916	120,000	77
6	Broad River	nr Gaffney, S. C.	1490	August 14, 1940	119,000	80
7	French Broad River	at Marshall, N. C.	1332	July 16, 1916	115,000	86
8	Hiwassee River	nr Reliance, Tenn.	1223	September 1898	90,000	74
9	Nolichucky River	nr Greeneville, Tenn.	1141	May 22, 1901	110,000	96
10	French Broad River	at Asheville, N. C.	945	July 16, 1916	110,000	116
11	Broad River	nr Boiling Springs, N. C.	864	August 16, 1928	73,300	85
12	Nolichucky River	at Embreeville, Tenn.	805	May 22, 1901	120,000	149
13	Tuckaseegee River	at Bryson City, N. C.	655	May 1840	90,000	137
14	Watauga River	at Butler, Tenn.	427	August 13, 1940	71,500	167

Another early large storm occurred on May 18-21, 1901. This was one of the most severe known in the upper eastern portion of the Valley, particularly on the Nolichucky and Watauga Rivers, and lower portions of the South Fork Holston River. Approximately 8 inches of rain fell in a 24-hour period on ground that had been saturated from earlier rains. The numerous waterspouts and landslides that were reported attest to the intensity of the rainfall. The resulting flood became known as the "May Tide" on the Nolichucky River.

The storm of July 15-16, 1916, was the second of two tropical hurricanes that moved inland over the southeastern portion of the country during July 1916. The first hurricane, although it dissipated over southern Alabama, brought sufficient rainfall to western North Carolina on July 8-10 to saturate the ground. The second hurricane which followed brought extremely heavy rain on July 15-16 to the mountains of western North Carolina, with a recorded maximum of 22.2 inches in a 24-hour period at Altapass, about 38 miles east of Marshall. Particularly devastating floods resulted on the upper French Broad River and headwater tributaries in the Blue Ridge mountains. A description of this great storm and flood is contained in Section II.

All of the floods listed in Table 7 have occurred on watersheds in the Marshall region whose physical characteristics are generally similar to those of the French Broad River watershed. This indicates that floods of like magnitude, modified to take into account differences in drainage area characteristics, could occur in the future on the French Broad River. However, an important characteristic of the French Broad River must be taken into account in modifying floods on other streams of the region, as has been described in Section II of this report. This is the broad flood plain and unusually flat slope of the 70-mile reach of the river between Rosman and Asheville. The substantial natural storage of flood waters which occurs in this reach has a significant effect on the timing and crest discharge of floods at Marshall.

French Broad River vs. Regional Flood Discharges

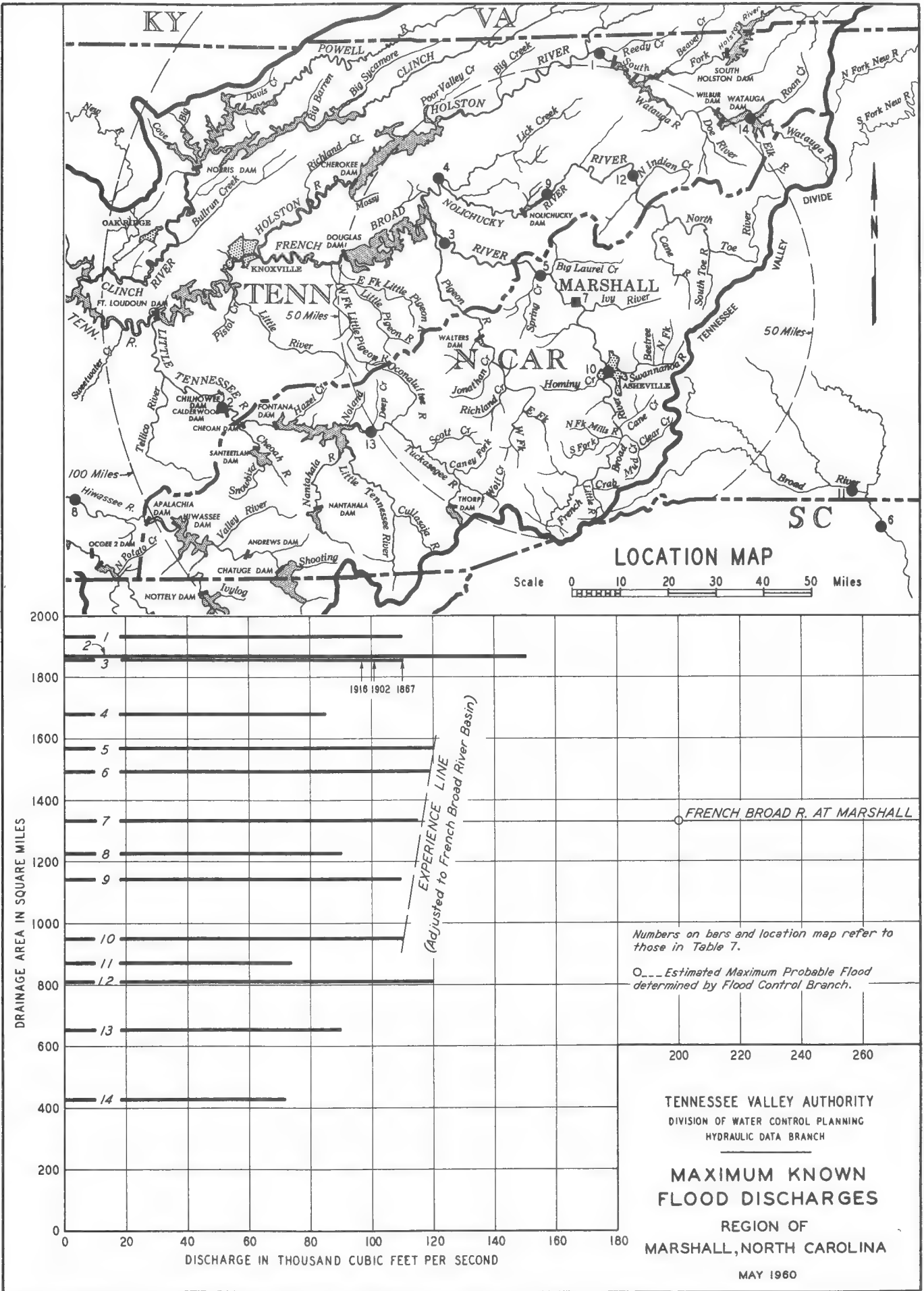
Plate 7 includes a diagram of the discharges tabulated in Table 7 and also a map showing the locations of the discharge measurements. The diagram

shows that only two known floods in the region, one on the Little Tennessee River in 1867 and the other on the Nolichucky River in 1901, exceeded the 1916 flood on the French Broad River.

If these two floods should be used as the criteria for establishing the magnitude of a Regional Flood at Marshall, the peak flow there would be 135,000 cubic feet per second. However, although the watersheds of the Little Tennessee and Nolichucky Rivers are comparable to that of the French Broad above Marshall, there is one very significant difference in the stream valleys themselves. The French Broad valley upstream from Asheville is relatively flat and provides an exceptionally large natural storage basin for flood waters. The effect of this is to reduce flood peaks on the French Broad downstream from Asheville. Since this is the situation, it would be expected that the Regional Flood crest at Marshall would be less than the 135,000 cubic feet per second that would occur if based on the Nolichucky and Little Tennessee Rivers flood experience where no unusual natural storage basins exist.

The flood of July 16, 1916, covered a large area including and surrounding the Upper French Broad River watershed. In studies of the 1916 flood on other watersheds, it has been found that this flood has determined the magnitude of the Regional Flood. Since this is the case, it is logical to consider that this flood should be used as the Regional Flood at Marshall. The peak of the 1916 flood at Marshall is estimated to have been 115,000 cubic feet per second which, in effect, gives credit to the natural storage above Asheville for a reduction of 20,000 cubic feet per second from what the peak would have been had this storage not been in existence. Accordingly, the Regional Flood at Marshall is determined to be one the peak discharge of which is the same as that of the July 16, 1916 flood.

The profile of the 1916 flood which is the Regional Flood in the Marshall vicinity is shown on Plate 10.



IV.

MAXIMUM PROBABLE FLOOD

Tennessee Valley Authority
Division of Water Control Planning
Flood Control Branch

IV.

MAXIMUM PROBABLE FLOOD

The preceding sections have told about the floods that have occurred on and in the region of the French Broad River near Marshall, North Carolina. This section discusses the Maximum Probable Flood that may reasonably be expected. Floods of this magnitude are the kind considered in planning the construction and operation of protective works, the failure of which might be disastrous.

The French Broad River drains 1,343 square miles at Redmon Dam, near the lower limit of the present study and 1,332 square miles at the U. S. Geological Survey stream gage near the upper end. Extreme floods on this stream may result from either of two types of storms--intense periods of rainfall during winter storms of fairly long duration or short-duration storms of the cloudburst or hurricane type usually occurring in the summer. Infiltration and other losses are generally low in winter and generally high in summer.

DETERMINATION OF MAXIMUM PROBABLE FLOOD

In determining the Maximum Probable Flood on the French Broad River, consideration was given to great storms and floods that have already occurred on this watershed and to those which have occurred elsewhere but could have occurred on this area. This procedure provides information about possible flood and storm occurrences additional to that which can be gained from the short-term local hydrologic records alone.

The maximum known flood on the French Broad River in the vicinity of Marshall occurred in July 1916 with a discharge of about 115,000 cubic feet per second at the Geological Survey gage where the drainage area is 1,332 square miles. It is reasonable to expect that greater floods than those of the known past will occur on the French Broad River.

Observed Storms

Observed storms are meteorologically transposable to the French Broad River watershed from within a broad region extending generally from the Atlantic Ocean to the Appalachian Divide and from Florida through Pennsylvania. The moisture source for storms in this region is the warm, moist air flowing northward from the tropical Atlantic Ocean. In general, the moisture potential for a given region decreases with its distance from the moisture source. When transferring storms within the broad region to the French Broad River watershed, appropriate adjustments were made for differences in this moisture potential. The mountains surrounding this watershed have a marked influence on the storm patterns, and allowance also was made for this influence.

Table 8 lists known rainfall depths for several large storms transposable to this watershed.

TABLE 8
SELECTED MAXIMUM OBSERVED STORMS

<u>Date</u>	<u>Location</u>	<u>Rainfall Depth, Inches</u>
		<u>1, 343 Square Miles, 6-Hour Duration</u>
July 1916	North Carolina	5.5
August 1939	New Jersey	6.5
September 1940	New Jersey	7.8
October 1941	Florida	6.5

On the basis of these and other data, as adjusted for conditions in the watershed, a rainstorm of 10.8 inches in 6 hours was adopted for computing the Maximum Probable Flood for the 1,343-square-mile area above Marshall.

Storms greater than this can occur. Storms considered to be the greatest from a meteorological standpoint would be approximately twice that adopted for the Maximum Probable Flood at Marshall.

Observed Floods

Factors such as the meteorology of the region and flood-producing characteristics of the watershed were given consideration in determining whether peak discharges on other streams are applicable to the French Broad River. In addition to the floods listed in Table 7 of Section III, Table 9 lists peak discharges for observed floods on several streams of approximately the size of the French Broad River. For comparison, the discharge of the highest flood at Marshall is listed.

TABLE 9
SELECTED MAXIMUM OBSERVED FLOODS
IN VICINITY OF MARSHALL, NORTH CAROLINA

<u>River</u>	<u>Location</u>	<u>Drainage Area Sq. Mi.</u>	<u>Date</u>	<u>Peak Discharge</u>	
				<u>CFS</u>	<u>CFS Per Sq. Mi.</u>
Yadkin	Wilkesboro, N. C.	493	1940	160,000	325
French Broad	Bent Creek, N. C.	676	1916	105,000	155
James	Lick Run, Va.	1,369	1877	120,000	88
S. Br. Potomac	Springfield, W. Va.	1,471	1877	140,000	95
Catawba	Catawba, N. C.	1,535	1940	177,000	115
Little Tennessee	Fontana Dam, N. C.	1,571	1867	129,000	82
French Broad	Marshall, N. C.	1,332	1916	115,000	86

Maximum Probable Flood Discharges

From consideration of the flood discharges in Tables 7 and 9 and of the transposition to the French Broad River area of outstanding storms, the peak discharge of the Maximum Probable Flood was determined to be 200,000 cubic feet per second at Marshall.

This flood rate was computed from the adopted storm using the unit hydrograph technique. The peak rate is approximately twice the greatest known flood.

The Maximum Probable Flood at Marshall can result from two types of storm situations. In one, the situation presented in this report, the storm covers the entire area with the center being located above Asheville, North Carolina. In the other situation, the storm centers over the watershed between Marshall and Asheville. The magnitude of the flood crest is essentially the same for either assumption.

Frequency

The frequency of a flood of the magnitude of the Maximum Probable is not susceptible of definite determination. Such a flood would occur on the average only at rather long intervals of time, but it could occur in any year.

Possible Larger Floods

Floods larger than any of those discussed are hydrologically possible. However, the combination of factors that would be necessary to produce such floods would occur at rare intervals. The consideration of floods of this magnitude is of greater importance in some problems than in others and should not be overlooked in the study of any problem. Such floods, because of their extreme rarity and uncertainty of occurrence on a given watershed, need be given greatest consideration where dependence is placed on protective works, the failure of which would cause loss of life or destruction of valuable property.

FLOOD HEIGHTS AND VELOCITIES

Flood Crest Profiles and Overflow Areas

The crest profile computed for the Maximum Probable Flood on the French Broad River in the vicinity of Marshall is shown on Plate 10. This profile was computed using stream characteristics for selected reaches as determined from observed flood profiles, topographic maps, and valley cross sections. The cross sections for the portion of the stream below Mile 126¹ were surveyed in

1941-42. Four other sections were surveyed in 1960. The overflow areas that would be covered by the Maximum Probable Flood are approximately the same as those for the July 1916 flood shown on Plate 8.

The Maximum Probable Flood profile is from 9 to 17 feet above elevations experienced in the 1916 flood. Figures 12 to 15 show the depth of these two floods in the business district of Marshall. The greatest difference occurs at Capitola Dam, a concrete structure built to replace the timber crib dam that was heavily damaged at the time of the 1916 flood. The Maximum Probable Flood profile on Plate 10 is for present-day conditions.

It is impossible to foretell the destructive effect of velocities (see Velocities and Rates of Rise) on bridges over the stream, the dams, and structures bordering the stream. In computing the profile of the Maximum Probable Flood there was no choice but to assume the survival of all structures. The open guard-rail on the new concrete bridge was assumed to be clogged with debris. The steel truss bridge immediately below Capitola Dam was assumed to be 25 percent clogged.

The elevations shown on Plate 10 and the overflow area shown on Plate 8 have been determined as accurately as possible consistent with the basic data, but actual elevations may vary from those shown on the maps. To determine elevations and flooded area limits more accurately would require costly surveys.

Velocities and Rates of Rise

During the Maximum Probable Flood, velocities in the main channel of the French Broad River would range from about 8 to 18 feet per second, the highest velocity occurring at the upper limit of the study where the total stream cross section is smaller than at any other place within the limits of the study. Higher rates under bridges or over Capitola Dam may be experienced. In the overflow area, velocities would range from about 1 to 17 feet per second with the higher velocity occurring in the highway passing through the center of the town.

The Maximum Probable Flood would rise about 37 feet above low water to its crest stage in about 8 hours. The maximum rate of rise would be about 6 feet in 1 hour.

These high velocities and rapid rates of rise in combination with deep flooding would create an extremely hazardous situation, especially on the narrow, highly developed flood plain on which Marshall is situated.



Figure 12.--MAXIMUM PROBABLE AND REGIONAL FLOODS AT MARSHALL

Both of these views are northwestward along Main Street. The top picture shows the Southern Railway depot and Teague Milling Company at the upper end of the business district. The lower view shows business buildings upstream from Upper Bridge Street. The arrows and dashed lines indicate the height of the Maximum Probable Flood and of the Regional Flood which is the same as the July 1916 flood. The difference between the two floods is 16 to 17 feet.



Figure 13. --BUILDINGS NEAR MADISON COUNTY COURT HOUSE

These views are on Main Street at its intersection with Lower Bridge Street. The upper view shows the court house and the Bank of French Broad. The lower view is southeastward along Main Street showing business buildings upstream from Lower Bridge Street. Arrows and dashed lines identify the height of the Maximum Probable and Regional (1916) Floods. The difference between the two floods in these views is about $14\frac{1}{2}$ to 15 feet.



Figure 14. --FLOOD HEIGHTS ALONG MAIN STREET

The top view is west along Main Street from its intersection with Upper Bridge Street. The Marshall Post Office is in the center of the picture. The bottom view is east along Main Street near the lower end of the business section. Arrows and dashed lines show the height of the Maximum Probable and Regional (1916) Floods. The difference between the two floods is about 15 feet in the upper view and 14 feet in the lower view.

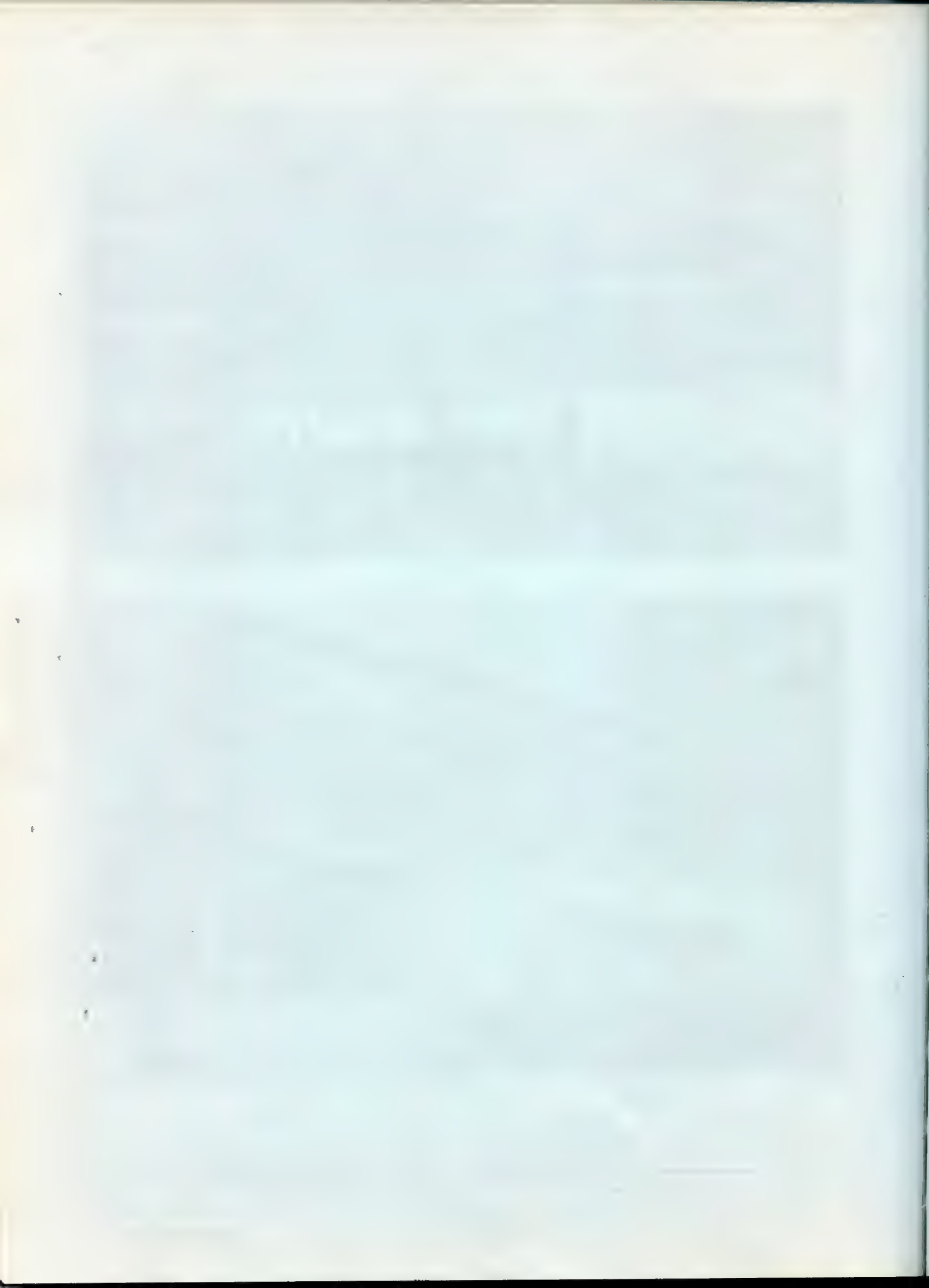


Figure 15. --MARSHALL SCHOOL BUILDINGS

The top view shows the Marshall School cafeteria and grade school on the left and the high school in the background. The new shop and gymnasium building is in the bottom view. The arrows and dashed lines show the Maximum Probable and Regional (1916) Floods. The difference between the two floods in these views is about 14 feet.

V

ACKNOWLEDGMENTS



Tennessee Valley Authority
Division of Water Control Planning

V.

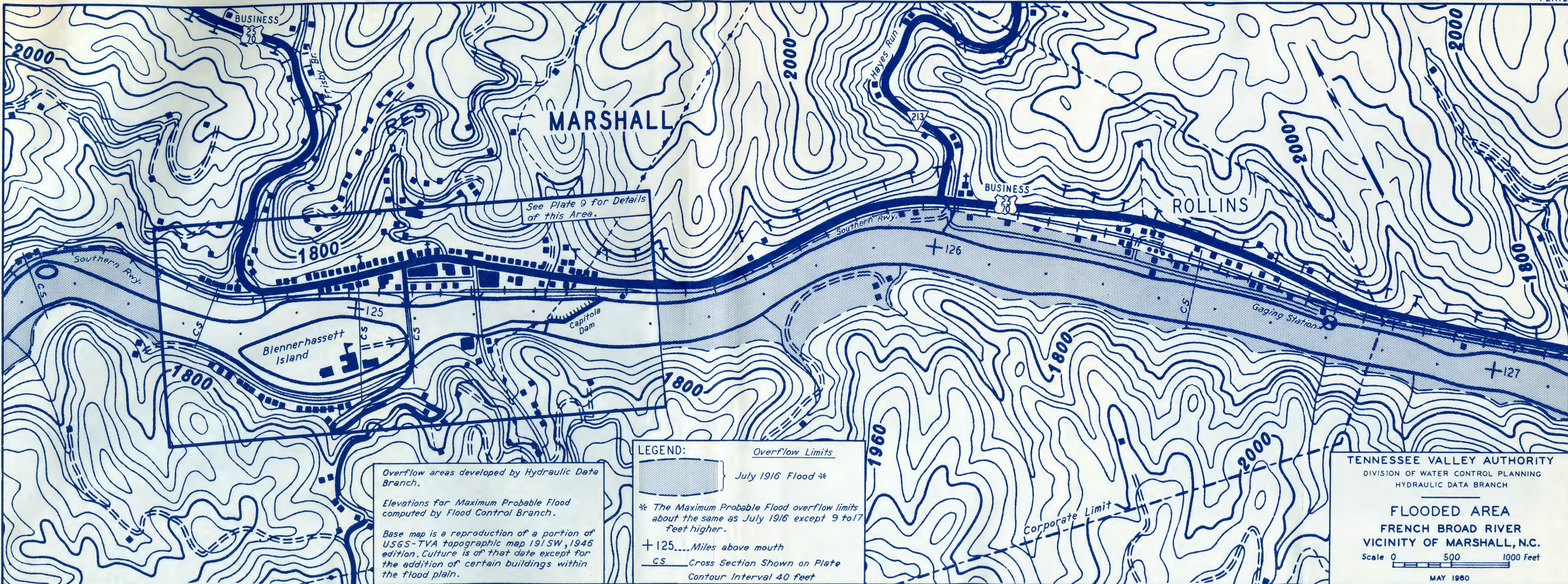
ACKNOWLEDGMENTS

This report has been prepared by the Division of Water Control Planning under the general direction of Reed A. Elliot, Chief Water Control Planning Engineer.

All of the report except Section IV has been prepared by the Hydraulic Data Branch under the immediate supervision of Albert S. Fry, Chief, Hydraulic Data Branch. The report has been edited by James Smallshaw, Assistant Branch Chief. Investigations for compiling Section II, Flood History, were made under the direction of James W. Beverage, Head of the Field Investigations Section, by District Engineer Myron O. Jensen and Area Engineer Joseph S. Enloe. Paul C. Spath, Head of the Hydraulic Investigations Section, and Thomas C. Bounds, Head of the Office Engineering Unit, prepared charts and maps for the report and, together with Mr. Smallshaw and Mr. Enloe analyzed the flood information. The entire report was typed for reproduction by Margaret C. Longmire under the direction of Elizabeth G. Breeden, Head, Administrative Unit. The report cover and photographs in the report were prepared for reproduction by Mr. Bounds and by Robert Forbes of the Engineering Administration Section.

Section IV, Maximum Probable Flood, was prepared by the Flood Control Branch under the immediate direction of Edward J. Rutter, Chief, Flood Control Branch. Basic hydraulic data were furnished by the Hydraulic Data Branch. Flood studies were under the supervision of B. J. Buehler, Head, Operation Studies Section. The flood discharges were determined by Donald W. Newton, and the profiles were computed by Logan A. Gillett and Bevan W. Brown, Jr.

Photographs showing the height of the Maximum Probable Flood were taken by TVA photographer Lloyd C. Bloomer. The cover picture and several figures in the report are Asheville "Citizen-Times" photographs.



See Plate 9 for Details of this Area.

Overflow areas developed by Hydraulic Data Branch.

Elevations for Maximum Probable Flood computed by Flood Control Branch.

Base map is a reproduction of a portion of USGS-TVA topographic map 191 SW, 1946 edition. Culture is of that date except for the addition of certain buildings within the flood plain.

LEGEND:

Overflow Limits

 July 1916 Flood *

* The Maximum Probable Flood overflow limits about the same as July 1916 except 9 to 17 feet higher.

+125....Miles above mouth

CS Cross Section Shown on Plate

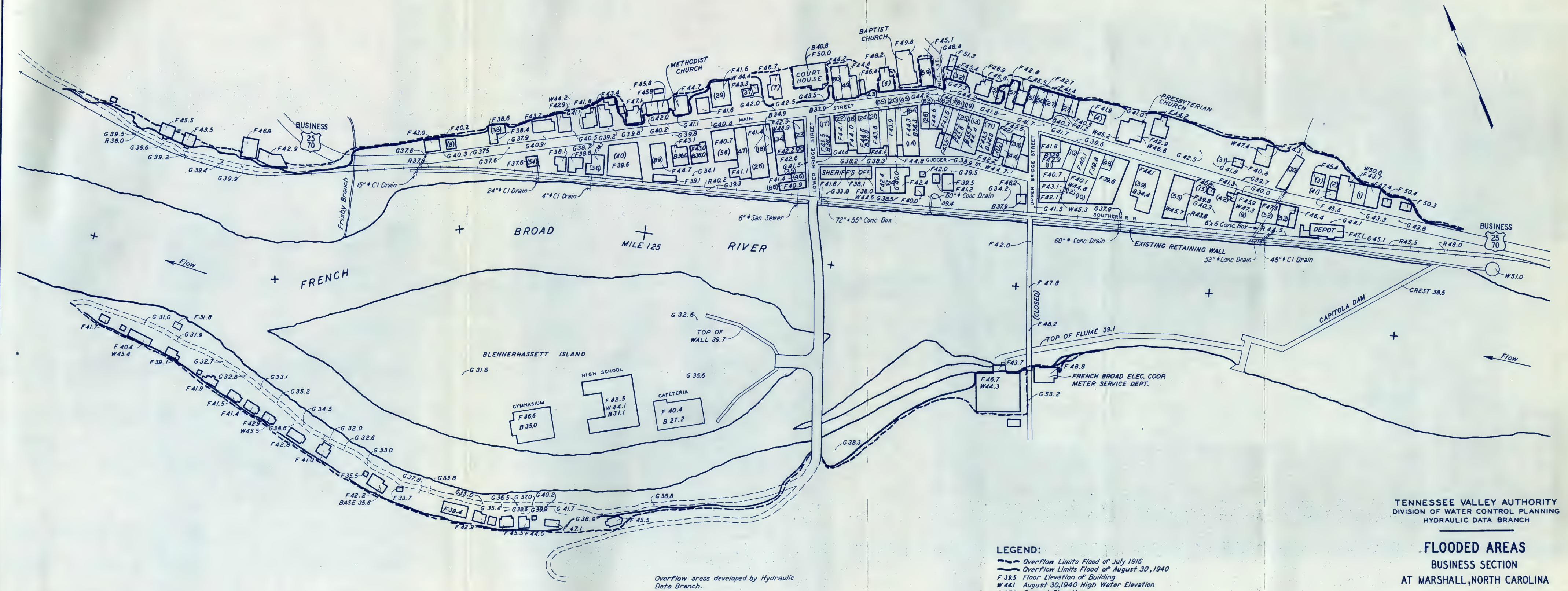
Contour Interval 40 feet

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

FLOODED AREA
FRENCH BROAD RIVER
VICINITY OF MARSHALL, N.C.

Scale 0 500 1000 Feet

MAY 1960



Overflow areas developed by Hydraulic Data Branch.

Map is a revision of Plate 34 in the TVA report "Flood Control for Upper French Broad River and Tributaries."

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HYDRAULIC DATA BRANCH

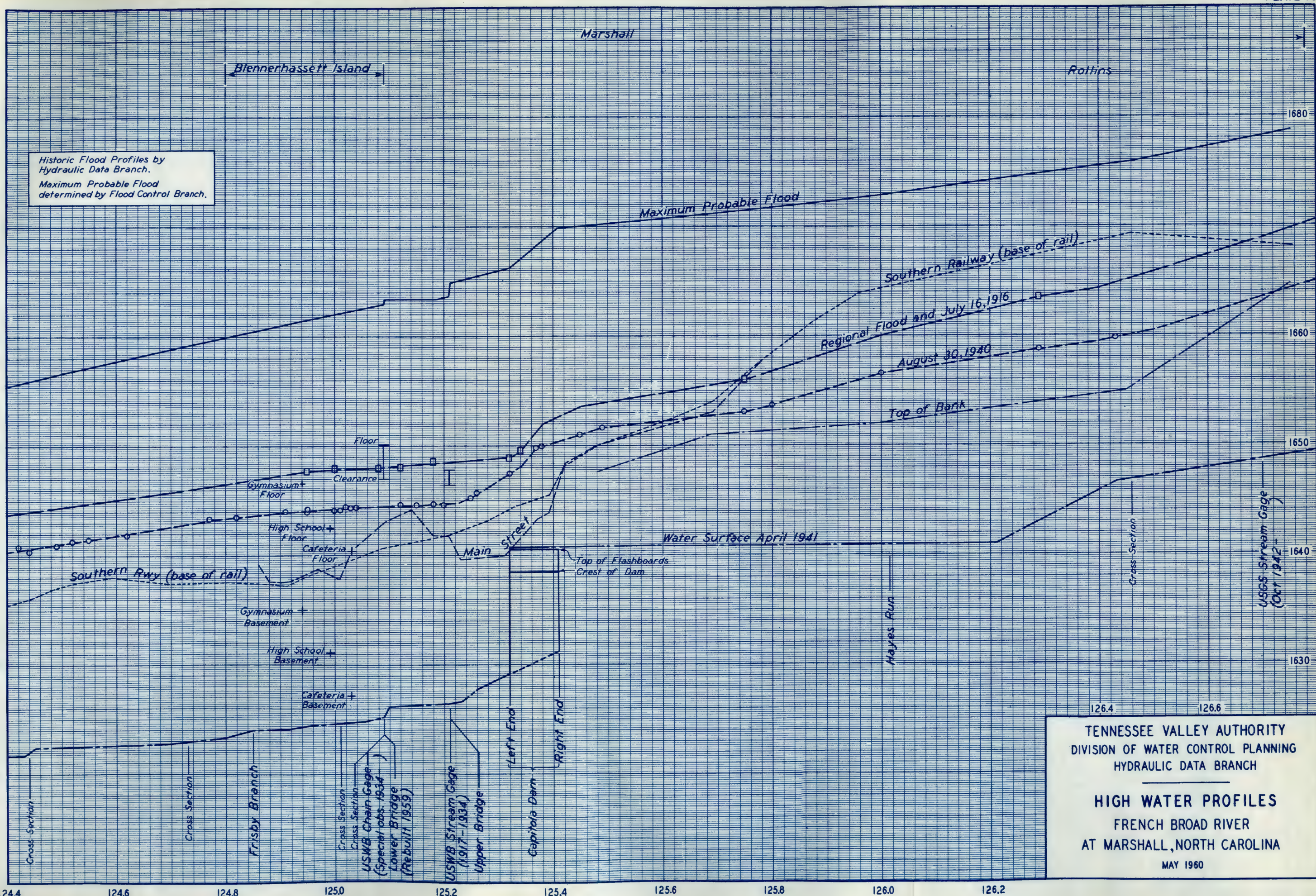
FLOODED AREAS
BUSINESS SECTION
AT MARSHALL, NORTH CAROLINA

SCALE 100 0 100 200 300 FEET

MAY 1960



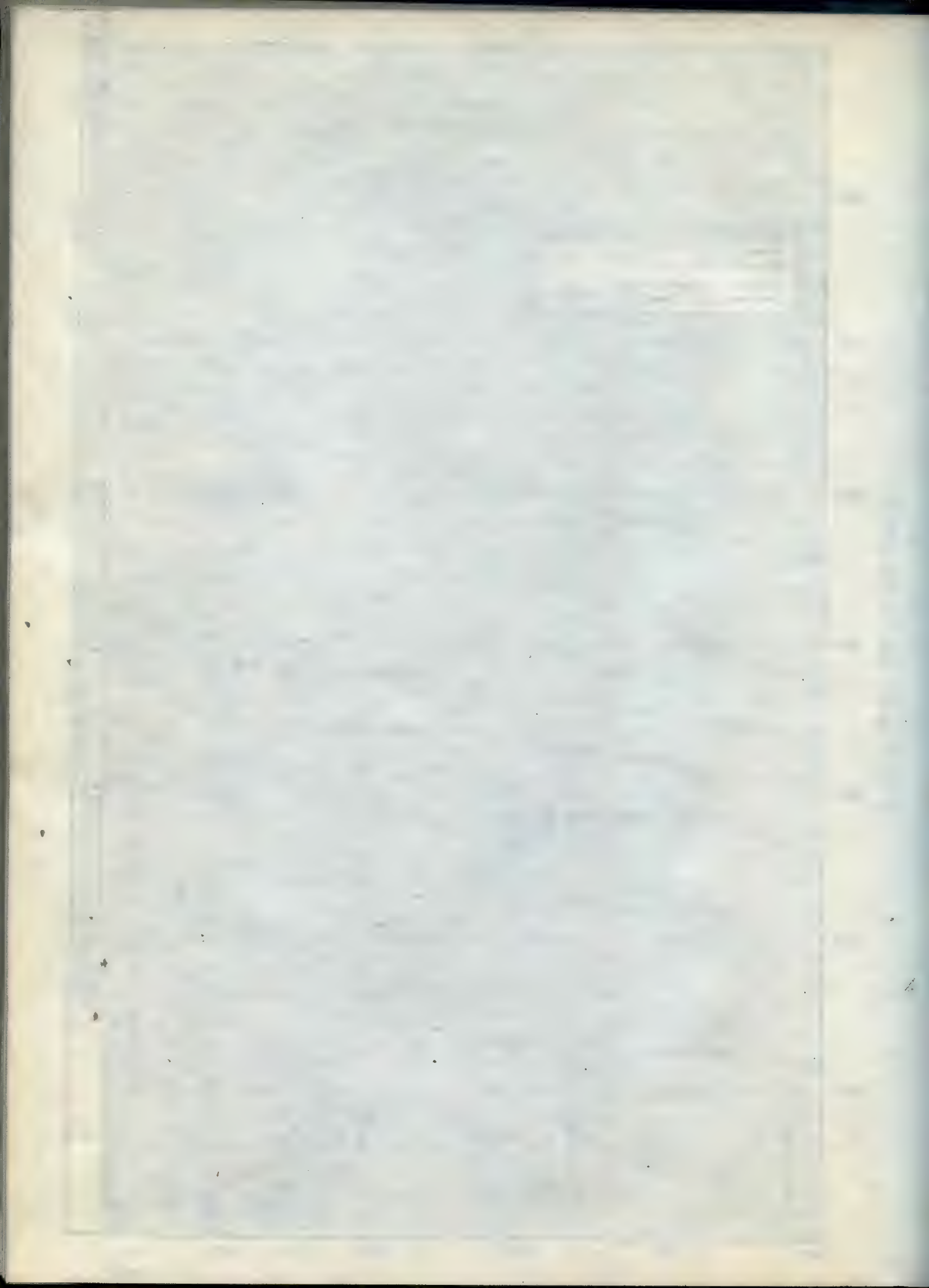
ELEVATION IN FEET (USC & GS 1936 SUPPL. ADJ.)

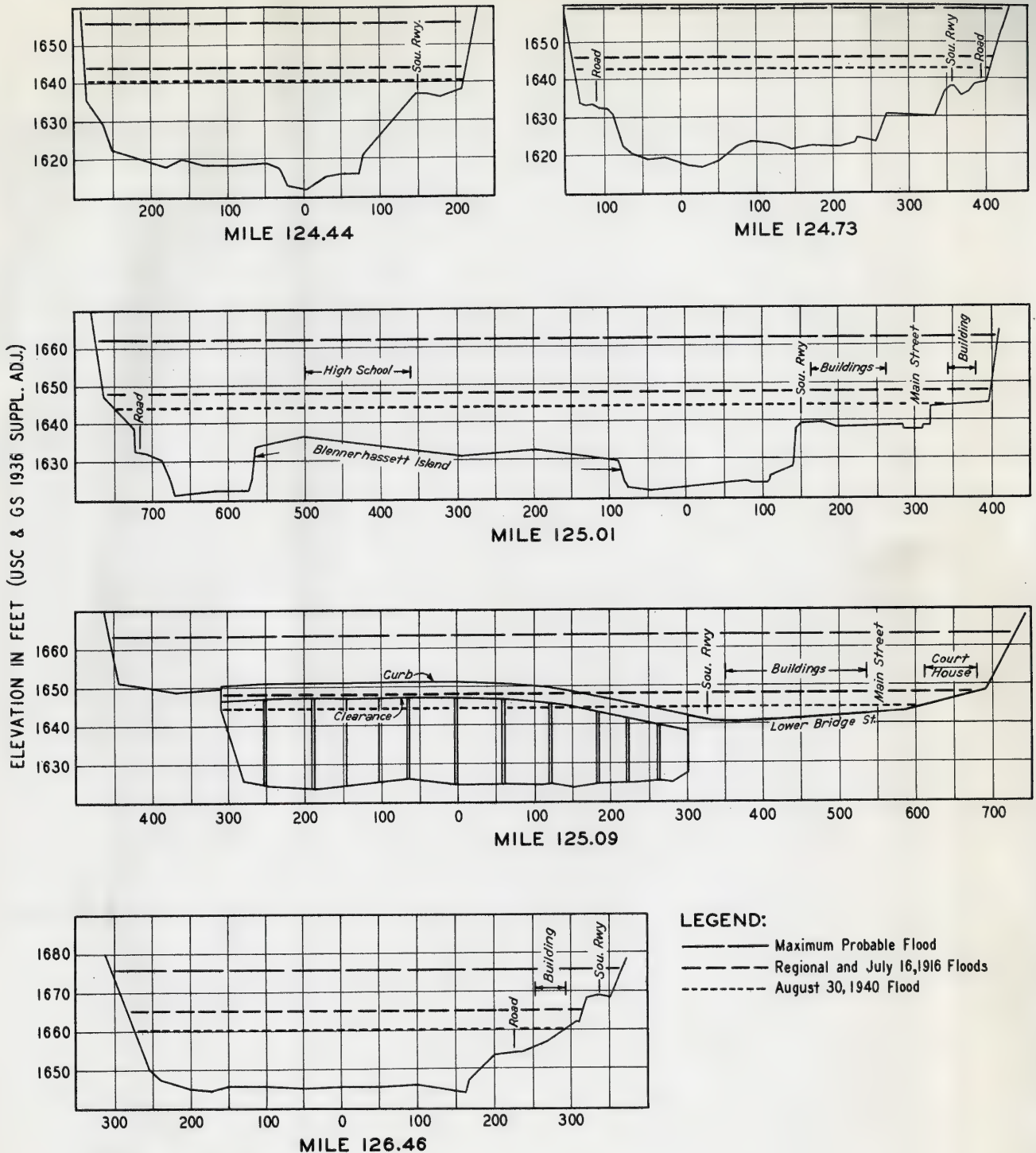


Historic Flood Profiles by
Hydraulic Data Branch.
Maximum Probable Flood
determined by Flood Control Branch.

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

HIGH WATER PROFILES
FRENCH BROAD RIVER
AT MARSHALL, NORTH CAROLINA
MAY 1960





Sections taken looking downstream.

Elevations of Maximum Probable Flood determined by Flood Control Branch.

Elevations of July 16, 1916 and August 30, 1940 floods by Hydraulic Data Branch.

Sections by Carter & Bearden Engineers, Asheville, N.C., and by Hydraulic Data Branch.

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

VALLEY CROSS SECTIONS
FRENCH BROAD RIVER
AT MARSHALL, N.C.

MAY 1960

HORIZONTAL DISTANCE IN FEET



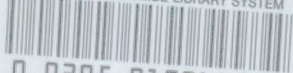
APACK

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FLOODS ON FRENCH BROAD RIVER

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